

DIVISION 9 MATERIALS**SECTION 9-00 DEFINITIONS AND TESTS****9-00.1 FRACTURE**

Fractured aggregate is defined as aggregate particles which have one or more fractured faces. A face will be counted as fractured whenever one-half or more of the projected area of the particle is comprised of a fractured face when viewed normal to the fractured face.

9-00.2 WOOD WASTE

Wood waste is defined as all Material which, after drying to constant weight, has a specific gravity of less than 1.0.

9-00.3 TEST FOR WEIGHT OF GALVANIZING

At the option of the Engineer, the weight of zinc in ounces per square foot required by the various galvanizing Specifications may be determined by an approved magnetic thickness gage calibrated within last 6 months for accuracy and demonstrated to the approval of the Engineer, in lieu of the other methods specified.

9-00.4 SIEVE ANALYSIS OF AGGREGATES

Sieve analysis for acceptance of aggregate gradation will comply with procedures described in Section 9-03.15.

9-00.5 DUST RATIO

The dust ratio is defined as the percent of material passing the U.S. No. 200 sieve divided by the percent of material passing the U.S. No. 40 sieve.

9-00.6 SAND/SILT RATIO

The sand/silt ratio is defined as the percent of material passing the U.S. No. 10 sieve divided by the percent of material passing the U.S. No. 200 sieve.

9-00.7 GALVANIZED HARDWARE, AASHTO M 232

An acceptable alternate to hot-dip galvanizing in accordance with AASHTO M 232 will be zinc coatings mechanically deposited in accordance with AASHTO M 298, providing the minimum thickness of zinc coating is not less than that specified in AASHTO M 232, and the process does not produce hydrogen embrittlement in the base metal. Sampling and testing will be made by the Engineer in accordance with commonly recognized national standards and methods used in the SPU Materials Laboratory.

SECTION 9-01 PORTLAND CEMENT**9-01.1 TYPES OF CEMENT**

Cement other than masonry cement shall be classified as Portland cement Type II or Type III. A "sack" of cement shall mean one cubic foot of Portland cement weighing 94 pounds.

9-01.2 CEMENT SPECIFICATIONS**9-01.2(1) TYPE II PORTLAND CEMENT**

Type II cement shall conform to the requirements for Type II cement of the Standard Specifications for Portland cement, AASHTO M 85, except that the content of alkalies shall not exceed 0.75 percent by weight calculated as Na_2O plus $0.658 \text{ K}_2\text{O}$.

Type II cement shall meet the requirements of the above Specifications for compressive strength and for time of setting by the Vicat method, AASHTO T 131.

9-01.2(2) TYPE III PORTLAND CEMENT

Type III Portland cement (H.E.S. or high early strength) shall conform to the requirements for Type III cement of the Standard Specifications for Portland cement, AASHTO M 85, except that the content of alkalies shall not exceed 0.75 percent by weight calculated as Na_2O plus $0.658 \text{ K}_2\text{O}$. It shall meet the requirements of the above Specifications for compressive strength and for time of setting by the Vicat method, AASHTO T 131. Type III Portland cement in cloth bags shall not be used.

9-01.2(3) LOW ALKALI CEMENT

The percentage of alkalies in low-alkali cement shall not exceed 0.60 percent by weight calculated as Na_2O plus $0.658 \text{ K}_2\text{O}$. This limitation shall apply to all types of Portland cement. Percentage of alkalies shall be determined in accordance with ASTM C 114.

9-01.2(4) BLENDED HYDRAULIC CEMENT

Blended hydraulic cement shall conform to the requirements for Type IP (MS) or Type I (PM)(MS) cement of AASHTO M 240 "Standard Specification for Blended Hydraulic Cements", with the additional requirement that the maximum fly ash content shall be 20 percent of the cementitious Material. The source of the fly ash, as well as the weight of fly ash as a percent by weight of total cement plus fly ash, shall be certified on the cement mill test certificate.

9-01.3 TESTS AND ACCEPTANCE

Cement may be accepted by the Engineer based on the manufacturer's Certification of Cement Shipment indicating full conformance to the Specifications. All shipments of the cement to the Contractor or concrete Supplier shall be accompanied by a Certification of Cement Shipment. The concrete Supplier or Contractor shall countersign three copies of this certificate and submit all three copies to the Engineer.

Each mixing facility or plant utilizing Portland cement shall be equipped with a suitable means or device for obtaining a representative sample of the cement. The device shall enable the sample to be readily taken in proximity to the cement weigh hopper and from a container or conveyor holding only cement.

9-01.4 ON-SITE STORAGE

The cement shall be stored on the site in a manner as to permit easy access for inspection and identification.

Cement shall be adequately protected at all times from rain and dampness. Cement which, in the opinion of the Engineer, contains lumps that can not be pulverized in the mixer will be rejected.

Type III Portland cement stored by the Contractor for a period longer than 30 Days, or Type II Portland cement stored by the Contractor for a period longer than 60 Days, shall be held for retest. If the cement has lost strength during the period of storage, as shown by tests conducted by SPU Materials Laboratory, sufficient additional cement shall be added to the mix to overcome such loss, or the cement may be rejected. The amount of cement to be added to the mix shall be determined by the Engineer.

9-01.5 CONTROLLED DENSITY FILL (CDF) – PIPE BEDDING AND TRENCH BACKFILL

For filling pipe and for filling the annular space between 2 pipes, see Section 9-05.23.

For pipe bedding, the following CDF mix design shall be used:

PIPE BEDDING CDF	
MATERIAL	QUANTITY
Portland Cement Type I-II	94 pounds per cubic yard
Fly Ash	300 pounds per cubic yard
Sand, Type 7	2800 pounds per cubic yard
Water	300 pounds per cubic yard
Air Entrainment	10 ounce per cubic yard

Slump shall not exceed 7 inch.

For trench backfill, the following CDF mix design shall be used:

TRENCH BACKFILL CDF	
MATERIAL	QUANTITY
Portland Cement Type I-II	30 pounds per cubic yard
Fly Ash	300 pounds per cubic yard
Sand, Type 7	2860 pounds per cubic yard
Water	300 pounds per cubic yard
Air Entrainment	10 ounce per cubic yard

Slump shall not exceed 7 inch.

9-01.6 POZZOLAN

Pozzolan shall meet the requirements of ASTM C 618-80, Class C, Class F, or Class N.

SECTION 9-02 BITUMINOUS MATERIALS**9-02.1 ASPHALT MATERIAL****9-02.1(1) GENERAL**

Asphalt furnished under these Specifications shall not have been distilled at a temperature high enough to injure by burning or to produce flecks of carbonaceous matter, and upon arrival at the Work, shall show no signs of separation into lighter and heavier components.

9-02.1(2) MEDIUM-CURING (MC) LIQUID ASPHALT

Characteristics	WSDOT Test Method	MC-70	MC-250	MC-800	MC-3000
Kinematic Viscosity at 140°F (cSt)	202	70-140	250-500	800-1600	3000-6000
Flash Point (Tag Open Cup) (Min. °F)	207	100	150	150	150
Water Content (Max. %)	217	0.2	0.2	0.2	0.2
Distillation: volume % of total distillate to 680 °F	211				
to 437°F		0-20	0-10	---	---
to 500°F		20-60	15-55	0-35	0-15
to 600°F		65-90	60-87	45-80	15-75
Residue of 680°F distillation % volume by difference (Min.)		55	67	75	80
Properties of residue from distillation to 680 °F					
Absolute viscosity at 140°F (poise)	203	300-1200	300-1200	300-1200	300-1200
¹ Ductility, 5 cm/min. at 77°F (Min.)	213	100	100	100	100
Solubility in trichloroethylene (Min. %)	214	99.0	99.0	99.0	99.0

¹If the ductility at 77°F is less than 100, the Material will be acceptable if its ductility at 60°F is more than 100.

The Material shall not foam when heated to the application temperature recommended in Section 5-02.3(3).

9-02.1(3) RAPID-CURING (RC) LIQUID ASPHALT

Characteristics	WSDOT Test Method	RC-70	RC-250	RC-800	RC-3000
Kinematic Viscosity at 140°F cSt	202	70-140	250-500	800-1600	3000-6000
Flash Point (Tag Open Cup) (Min. °F)	207	---	80	80	80
Water Content (Max. %)	217	0.2	0.2	0.2	0.2
Distillation: volume % of total distillate to 680°F	211				
to 374°F (Min.)		10	---	---	---
to 437°F (Min.)		50	35	15	---
to 500°F (Min.)		70	60	45	25
to 600°F (Min.)		85	80	75	70
Residue of 680°F distillation % volume by difference (Min.)		55	65	75	80
Properties of residue from distillation to 680°F					
Absolute viscosity at 140°F, poise	203	600-2400	600-2400	600-2400	600-2400
Ductility, 5 cm/min. at 77°F, cm Min.	213	100	100	100	100
Solubility in trichloroethylene Min. %	214	99.0	99.0	99.0	99.0

The Material shall not foam when heated to application temperature recommended in Section 5-02.3(3).

9-02.1(4) ASPHALT CEMENT**9-02.1(4)A PAVING ASPHALT**

Paving asphalt cement shall be PG 64-22 and shall meet the requirements of AASHTO MP1 for performance graded asphalt cement.

9-02.1(5) REJUVENATING (RECYCLING) AGENTS

The rejuvenating agent shall be a liquid emulsion of selected resin petroleum oil approved for use by the Materials Laboratory. Rejuvenating agents shall meet the following Specifications for the grade designated:

HOT MIX RECYCLING AGENTS¹

Test	ASTM Test Method	RA 5		RA 25		RA 75		RA 250		RA 500	
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Original Test											
Viscosity @ 140°F, cSt	D 2170 or D 2171	200	800	1000	4000	5000	10,000	15,000	35,000	40,000	60,000
Flashpoint, COC, °F	D 92	400	---	425	---	450	---	450	---	450	---
Saturates, Wt. %	D 2007	---	30	---	30	---	30	---	30	---	30
Specific Gravity	D 70 or D 1298	Report		Report		Report		Report		Report	
Residue test from RTFC	D 2872 ²										
Viscosity Ratio ³		---	3	---	3	---	3	---	3	---	3
Weight Change ± %		---	4	---	3	---	2	---	2	---	2

¹The final acceptance of recycling agents meeting this Specification is subject to the compliance of the reconstituted asphalt blends with the requirements in Section 9-02 for the class of asphalt mix required.

²The use of ASTM D 1754 has not been studied in the context of this Specification; however, it may be applicable. In cases of dispute, the reference method shall be ASTM D 2872.

³Viscosity Ratio = $\frac{\text{RTFC Viscosity at 140°F, cSt}}{\text{Original Viscosity at 140°F, cSt}}$

9-02.1(6) CATIONIC EMULSIFIED ASPHALTS

See the following Cationic Emulsified Asphalt Table.

CATIONIC EMULSIFIED ASPHALT																	
	Type	Rapid Setting				Medium Setting						Slow Setting				Special Track	
Grade	WSDOT Test Method	CRS-1		CRS-2		CMS-2S		CMS-2		CMS-2h		CSS-1		CSS-1h		STE-1	
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Test on Emulsions:																	
Viscosity Saybolt Furol S @ 77°F (25°C)	212	---	---	---	---	---	---	---	---	---	---	20	100	20	100	---	30
Viscosity Saybolt Furol S @ 122°F (50°C)	212	20	100	150	400	50	450	50	450	50	450	---	---	---	---	---	---
Storage stability test 1 day %	212	---	1	---	1	---	1	---	1	---	1	---	1	---	1	---	1
Demulsibility 35 m.l. 0.8% sodium dioctyl sulfosuccinate, % ¹	212	40	---	40	---	---	---	---	---	---	---	---	---	---	---	25	---
Coating ability & water Resistance:																	
Coating, dry aggregate	212	---	---	---	---	good	---	good	---	good	---	---	---	---	---	---	---
Coating, after spraying	212	---	---	---	---	fair	---	fair	---	fair	---	---	---	---	---	---	---
Coating, wet aggregate	212	---	---	---	---	fair	---	fair	---	fair	---	---	---	---	---	---	---
Coating, after spraying	212	---	---	---	---	fair	---	fair	---	fair	---	---	---	---	---	---	---
Particle charge test	212	positive		positive		positive		Positive		positive		positive ²		positive ²		positive	
Sieve Test, %	212	---	0.10	---	0.10	---	0.10	---	0.10	---	0.10	---	0.10	---	0.10	---	0.10
Cement mixing test, %	212	---	---	---	---	---	---	---	---	---	---	---	2.0	---	2.0	---	---
Distillation:																	
Oil distillate by vol. Of emulsions %	212	---	3	1.5	3	---	20	---	12	---	12	---	---	---	---	---	5
Residue, %	212	60	---	65	---	60	---	65	---	65	---	57	---	57	---	45	---
Tests on residue from distillation test:																	
Penetration, 77°F (25°C)	201	100	250	100	250	100	250	100	250	40	90	100	250	40	90	100	200
Ductility, 77°F (25°C) 5 cm/min., cm	213	40	---	40	---	40	---	40	---	40	---	40	---	40	---	40	---
Solubility in trichlorethylene, %	214	97.5	---	97.5	---	97.5	---	97.5	---	97.5	---	97.5	---	97.5	---	97.5	---

¹ The demulsibility test shall be made within 30 days from date of shipment.

² If the particle charge test for CSS-1 and CSS-1h is inconclusive, material having a maximum pH value of 6.7 will be acceptable.

This Page Intentionally Blank

9-02.1(7) ASPHALT FOR SUB-SEALING

Asphalt for sub-sealing shall conform to the requirements of AASHTO M 238 except that the minimum softening point shall be 170°F.

9-02.1(8) HOT MELT TRAFFIC BUTTON ADHESIVE

The bitumen adhesive Material shall conform to the following requirements:

Specification	ASTM Test Method	Requirement
Flash Point, COC °F	D 92	550 Min.
Softening Point, °F	D 36	200 Min.
Brookfield Viscosity, 400°F	D 2196	7,500 cP, Max.
Penetration, 100g, 5 sec, 77°F	D 5	10 - 20 dmm
Filler Content, % by weight (Insoluble in 1,1,1 Trichloroethane)	D 2371	50 - 75

Filler Material shall be calcium carbonate and shall conform to the following fineness:

Sieve Size	Percent Passing
No. 100	100
No. 200	95
No. 325	75

Hot melt bitumen adhesive shall develop bond pull-off strength greater than 100 psi between 0°F and 120°F.

9-02.1(9) COAL TAR PITCH EMULSION

Coal tar pitch emulsion shall conform to all requirements of Federal Specification R-P-355. The emulsion shall be prepared from straight run, high temperature, coke oven tar meeting the requirements of Federal Specification RC 1424. The emulsion shall be homogeneous and shall show no separation or coagulation of components that cannot be overcome by moderate stirring. It shall be capable of being applied completely by squeegee, brush, or other approved mechanical methods to the surface of bituminous pavements when spread at the specified rates.

9-02.2 SAMPLING AND ACCEPTANCE**9-02.2(1) CERTIFICATION OF SHIPMENT**

Bituminous Materials may be accepted by the Engineer based on the *Manufacturer's Certificate of Compliance* in the form of a Notice of Asphalt Shipment. This certification (Form 350-053 supplied by WSDOT will be provided by contacting the SPU Materials Laboratory at 206-386-1236) shall be supplied in triplicate at the time of shipment of each truck load, truck and trailer, or other lot of asphalt. All information required on the form shall be completed. The original copy shall be mailed on the Day of shipment to the SPU Materials Laboratory, the duplicate to the consignee; and the triplicate with the shipment.

9-02.2(2) SAMPLES

When requested by the Engineer, the asphalt Supplier shall ship, by prepaid express or US mail, samples of asphalt that represent current production to the SPU Materials Laboratory.

9-02.3 TEMPERATURE OF ASPHALT

The temperature of paving asphalts in storage tanks when loaded for transporting to destination shall not be greater than 400°F.

9-02.4 ANTI-STRIPPING ADDITIVE

When directed by the Engineer (see Sections 5-02.2, 5-02.3(11), and 5-04.3(20)), asphalt Material shall be treated with an approved heat-stable anti-stripping additive. The anti-stripping additive shall be added to the asphalt at the point of shipment and shall be a percentage designated by the Engineer, not to exceed 1 percent by weight of the asphalt. The anti-stripping additive shall be approved by the SPU Materials Laboratory prior to use. Once designated for use on the Project, the brand, grade, or percentage of anti-stripping additive shall not be changed.

SECTION 9-03 AGGREGATES**9-03.0 GENERAL**

Mineral Aggregates most commonly used have each been given a Type number to identify a unique Mineral Aggregate blend known as "Mineral Aggregate Type (No.)". See the definition of "Mineral Aggregate" in Section 1-01.3. Requirements for each Mineral Aggregate identified by a Type number are contained in Sections 9-03.9 through 9-03.16. Mineral Aggregates shall be composed of clean, uniform (in quality) particulate size groups essentially free from wood Waste

and other deleterious Materials. They shall be obtained only from sources approved by the Engineer. Written requests for source approval shall be submitted to the Engineer not less than 10 Days prior to the intended use of the Mineral Aggregate. *Should the proposed source be one that the Engineer has no history of Material performance with, the Engineer reserves the right to take preliminary samples at the proposed source, and make preliminary tests, to first determine acceptability of the new source and then perform the applicable Material approval testing.* Continued approval of a source is contingent upon the Mineral Aggregates from that source continuing to meet Contract requirements.

Mineral aggregates shall meet the Standard Specifications for grading and quality for use in the Work; however, allowable exceptions may be specified in Contract. The Engineer shall reserve the right to sample and test Mineral Aggregate at any time including at the source.

Crushed concrete shall meet the requirements specified in Sections 4-01.2 and 4-04.2 as applicable.

All percentages are by weight unless otherwise specified.

9-03.1 AGGREGATES FOR PORTLAND CEMENT CONCRETE

9-03.1(1) GENERAL REQUIREMENTS

Portland cement concrete aggregates shall be manufactured from ledge rock, talus, or sand and gravel in accordance with the provisions of Section 3-01. *They shall possess the characteristics of shape and size such that the concrete, resulting from a mixture of fine and coarse aggregates in the specified proportions, has workability acceptable to the Engineer.* Regardless of compliance with all other provisions of these Specifications, if the concrete is not of a workable character, or does not exhibit a proper surface when finished, either the fine or the coarse aggregate or both, will be rejected, or shall be altered as required by the Engineer.

If, in the judgment of the Engineer, based on previous experience or on Laboratory tests, concrete aggregates from a given source are detrimentally reactive with alkalis in Portland cement, corrective measures, including use of only low-alkali cement may be required as a condition of approval.

9-03.1(2) FINE AGGREGATE FOR PORTLAND CEMENT CONCRETE

9-03.1(2)A GENERAL

Fine aggregate for Portland cement concrete shall consist of sand or other inert Materials, or combinations thereof, approved by the Engineer, having hard, strong, durable particles free from adherent coating. Fine aggregate shall be washed thoroughly to remove clay, loam, alkali, organic matter, or other deleterious matter.

9-03.1(2)B DELETERIOUS SUBSTANCES

The amount of deleterious substances in the washed aggregate shall not exceed the following values:

1. Particles having a specific gravity less than 1.95 shall not exceed 1.0 percent of total weight.
2. Organic matter, by calorimetric test, shall not be darker than the reference standard color (organic plate No. 3) AASHTO T 21 unless other tests prove a darker color to be harmless.

9-03.1(2)C GRADING

Fine aggregate for Portland cement concrete shall be graded to conform to the following requirements expressed as percentages by weight:

	(Paving/State)		(Building/Concrete)	
	Class 1		Class 2	
	Max.	Min.	Max.	Min.
3/8 Square	100	100	---	---
% Passing U.S. No.4	100	95	100	95
% Passing U.S. No.8	86	68	95	85
% Passing U.S. No.16	65	47	80	45
% Passing U.S. No.30	42	27	60	40
% Passing U.S. No.50	20	9	30	10
% Passing U.S. No.100	7	0	10	2
% Passing U.S. No.200 (wet sieving)	2.5	0	2.5	0

Sieve Number	Permissible Variation in Individual Tests
No. 30 and coarser	2.0 percent
No. 50 and finer	0.5 percent

9-03.1(2)D USE OF SUBSTANDARD GRADINGS

Fine aggregate with more than the maximum percentage passing any sieve may be accepted provided the cement content of the finished concrete is increased, at the Contractor's cost, by 1/3 percent for each 1 percent the fine aggregate passing each sieve is in excess of the maximum.

Under no circumstances shall fine aggregate Class 1 be used which has a grading finer than the following:

Sieve Size	Percent Passing
U.S. No. 8	95
U.S. No. 16	80
U.S. No. 30	60
U.S. No. 50	25
U.S. No. 200	2.5

9-03.1(3) COARSE AGGREGATE FOR PORTLAND CEMENT CONCRETE**9-03.1(3)A GENERAL**

Coarse aggregate for Portland cement concrete shall consist of gravel, crushed stone, or other inert Material or combinations thereof approved by the Engineer, having hard, strong, durable pieces free from adherent coatings. Coarse aggregate shall be washed thoroughly to remove clay, silt, bark, sticks, alkali, organic matter, or other deleterious Material. When required by the Engineer, coarse aggregate shall be handpicked to remove harmful Material.

9-03.1(3)B DELETERIOUS SUBSTANCES

The amount of deleterious substances shall not exceed the following values:

Amount finer than U.S. No. 200	0.5 percent by weight
Pieces with a specific gravity less than 1.95	2.0 percent by weight
Clay lumps	0.5 percent by weight
Shale	2.0 percent by weight
Wood Waste	0.05 percent by weight

9-03.1(3)C WEAR IN LOS ANGELES MACHINE

Coarse aggregate shall not have a percentage of wear in the Los Angeles machine in excess of 35 after 500 revolutions in accordance with ASTM C 131.

9-03.1(3)D GRADING

Coarse aggregate for Portland cement concrete shall conform to one of the following gradings:

	Percent Passing							
	Grading No. 2		Grading No. 4		Grading No. 5		Grading No. 6	
Sieve Size	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
1-1/2" square	100	100	---	---	---	---	---	---
1-1/4" square	95	100	90	100	---	---	---	---
1" square	---	---	---	---	100	---	---	---
3/4" square	40	70	0	20	80	100	100	---
1/2" square	---	---	---	---	---	---	90	100
3/8" square	5	20	0	2	10	40	40	90
U.S. No. 4	0	2	---	---	0	4	5	30
U.S. No. 200	0	0.5	0	0.5	0	0.5	0	0.5

In individual tests, a variation of four percent under the minimum percentages or over the maximum percentages will be allowed. The average of three successive tests shall be within the percentages stated above. Coarse aggregate shall contain no pieces larger than two times the maximum sieve size for the specified grading measured along the line of greatest dimension.

Acceptance of grading and quality of the aggregate will be based on samples taken from stockpiles at the concrete plant. The exact point of acceptance will be determined in the field by the Engineer.

When the Engineer approves, the coarse aggregate may be blended from other sizes if:

1. The resulting aggregate meets all requirements for specified grading;

2. Each size used makes up at least 5 percent of the blend;
3. The Contractor supplies the Engineer with gradings for the proposed sizes, along with their proper proportions before producing the aggregate. If the aggregate comes from commercial sources, the Contractor shall supply this information and have it approved before proportioning and mixing the concrete.

In place of Grading No. 2, the Contractor may substitute a 50-50 mix of Grading Nos. 4 and 5.

9-03.1(3)E USE OF SUBSTANDARD GRADINGS

Coarse aggregate containing more than the maximum percentage passing any sieve may be accepted provided the cement content of the finished concrete is increased at the Contractor's sole expense. The cement content shall be increased) 0.25 percent for each 1 percent the amount passing each of the 3/4 inch, 3/8 inch, and No. 4 sieves is in excess of the maximum specified in 9-03.1(3)D. Coarse aggregate No. 2 shall not be used under any circumstances when the combined amount passing any of the following sieve sizes exceeds the following:

Sieve Size	Percent Passing
3/4" square	70
3/8" square	30
U.S. No. 4	5

Coarse aggregate No. 5 shall not be used under any circumstances when the combined amount passing any of the following sieve sizes exceeds the following:

Sieve Size	Percent Passing
3/8" square	50%
U.S. No. 4	8%

9-03.2 RESERVED

9-03.3 RESERVED

9-03.4 AGGREGATE FOR BITUMINOUS SURFACE TREATMENT

9-03.4(1) GENERAL REQUIREMENTS

Aggregate for bituminous surface treatment shall be manufactured from ledge rock, talus, or gravel, in accordance with Section 3-01, which meets the following test requirements:

Los Angeles Wear, 500 Rev.	35% max.
Degradation Factor	30 min.

9-03.4(2) GRADING AND QUALITY

Aggregate for bituminous surface treatment shall conform to the requirements in the following table for grading and quality. The particular type or grading to be used shall be as shown on the Drawings. All percentages are by weight.

The Material shall meet the requirements for grading and quality when placed in hauling vehicles for delivery to the roadway, or during manufacture and placement into a temporary stockpile. The exact point of acceptance will be determined by the Engineer.

SIEVE SIZE	Crushed Cover Stone	Crushed Screening - Percent Passing				
	Percent Passing	3/4" - 1/2"	5/8" - 1/4"	1/2" - 1/4"	3/8" - #10	1/4" - 0"
1" square	100	---	---	---	---	---
3/4" square	100	95-100	100	---	---	---
5/8" square	95-100	---	95-100	100	---	---
1/2" square	---	0-20	---	95-100	100	---
3/8" square	---	0-5	---	---	90-100	100
1/4" square	30-50	---	0-10	0-15	50-75	90-100
U.S. No. 10	---	---	0-3	0-3	0-10	30-60
U.S. No. 200	0-7.5	0-1.0	0-1.0	0-1.0	0-1.0	0-10.0
% fracture, by weight, min.	75	75	75	75	75	75
Sand equivalent min.	40	---	---	---	---	---
Static Stripping Test	Pass	Pass	Pass	Pass	Pass	Pass

The fracture requirement shall be at least one fractured face and applies to Material retained on each sieve size U.S. No. 10 and above if that sieve retains more than 5 percent of the total sample.

The finished product shall be clean, uniform in quality, and free from wood, bark, roots, clay, any organic material, and other deleterious materials.

Crushed screenings shall be substantially free from adherent coatings. The presence of a thin, firmly adhering film of weathered rock shall not be considered as coating unless it exists on more than 50 percent of the surface area of any size between successive laboratory sieves.

The portion of aggregate for bituminous surface treatment retained on the 1/4 inch sieve shall not contain more than 0.1 percent deleterious materials by weight.

9-03.5 RESERVED

9-03.6 AGGREGATES FOR ASPHALT TREATED BASE (ATB)

9-03.6(1) GENERAL REQUIREMENTS

Aggregates for asphalt treated base shall be manufactured from ledge rock, talus, or gravel, in accordance with the provisions of Section 3-01 that meet the following test requirements:

Los Angeles Wear, 500 Rev.	30% max.
Degradation Factor	15 min.

9-03.6(2) GRADING

Aggregates for asphalt treated base shall meet the following requirements for grading:

Sieve Size	Percent Passing
2"	100
1/2" square	56 - 100
1/4" square	40 - 78
U.S. No. 10	22 - 57
U.S. No. 40	8 - 32
U.S. No. 200	2.0 - 9.0
Asphalt Cement, Percent of Total Mixture	2.5 - 4.5

(Exact percentage of asphalt to be determined by the Engineer.)

Acceptance of the grading and quality of the aggregates will be based on samples taken from the final mix.

9-03.6(3) TEST REQUIREMENTS

When the aggregates are combined within the limits set forth in Section 9-03.6(2) and mixed in the *Materials Laboratory* with the designated grade of asphalt, the mixture shall be capable of meeting the following test values:

Stabilometer Value	30 min.
Cohesiometer Value	50 min.
Modified Lottman Stripping Test	Pass

The sand equivalent value of the mineral aggregate for asphalt treated base shall not be less than 35.

9-03.7 RESERVED

9-03.8 AGGREGATES FOR ASPHALT CONCRETE

9-03.8(1) GENERAL REQUIREMENTS

Aggregates for asphalt concrete shall be manufactured from ledge rock, talus, or gravel, in accordance with the provisions of Section 3-01. The Material from which they are produced shall meet the following test requirements:

Los Angeles Wear, 500 Rev.	30% max.
Degradation Factor, Wearing Course	30 min.
Degradation Factor, Other Courses	20 min.

It shall be uniform in quality, substantially free from wood, roots, bark, extraneous materials, and adherent coatings. The presence of a thin, firmly adhering film of weathered rock is not considered as coating unless it exists on more than 50 percent of the surface area of any size between consecutive laboratory sieves.

Aggregate removed from deposits contaminated with various types of wood waste shall be washed, processed, selected, or otherwise treated to remove sufficient wood waste so that the oven-dried Material retained on a 1/4 inch square sieve shall not contain more than 0.1 percent by weight of Material with a specific gravity less than 1.0.

9-03.8(2) TEST REQUIREMENTS

Aggregate for asphalt concrete shall meet the following test requirements:

	Class of Asphalt Concrete					
	A	B	D	E	F	G
Fracture, by weight (See Applicable Note)	1	2	3	4	4	2
Sand Equivalent (Min.)	40	40	---	40	30	40

- Notes
1. The fracture requirements are at least 1 fractured face on 90 percent of the Material retained on each sieve size U.S. No. 10 and above, if that sieve retains more than 5 percent of the total sample.
 2. The fracture requirements are at least 1 fractured face on 75 percent of the Material retained on each sieve size U.S. No. 10 and above, if that sieve retains more than 5 percent of the total sample.
 3. The fracture requirements are at least 2 fractured faces on 75 percent and at least 1 fractured face on 90 percent of the Material retained on each sieve, U.S. No. 8 and above, if that sieve retains more than 5 percent of the total sample.
 4. The fracture requirements are at least 1 fractured face on 50 percent of the Material retained on each sieve size U.S. No. 10 and above, if that sieve retains more than 5 percent of the total sample.

When Material is being produced and stockpiled for use on a specific contract or for a future contract, the fracture and sand equivalent requirements shall apply at the time of stockpiling. When Material is used from a stockpile that has not been tested as provided above, the requirements for fracture and sand equivalents shall apply at the time of its introduction to the cold feed of the mixing plant.

The properties of the aggregate in a preliminary mix design for asphalt concrete shall be such that when it is combined within the limits set forth in Section 9-03.8(6) and mixed in the Laboratory with the designated grade of asphalt, mixtures with the following test values can be produced:

	Class of Asphalt Concrete					
	A	B	D	E	F	G
Stabilometer Value, Min.	37	35	---	35	35	35
Cohesimeter Value, Min.	100	100	---	100	50	100
Percent Air Voids	2 - 4.5	2 - 4.5	---	2 - 4.5	2 - 4.5	2 - 4.5
Modified Lottman Stripping Test	Pass	Pass	Pass	Pass	Pass	Pass

The stabilometer value for asphalt concrete containing 50 % or more recycled asphalt concrete shall be 30 minimum.

Aggregates utilized in MC 250 and MC 800 asphalt concrete mixes shall meet the same requirements as the aggregates used in asphalt concrete Class B.

9-03.8(3) GRADING**9-03.8(3)A GRADATION - IMMEDIATE USE**

The Contractor may furnish aggregates for use on the same Contract from a single stockpile or from multiple stockpiles. The gradation of the aggregates shall comply in all respects with the pertinent requirements of Section 9-03.8(6).

Acceptance of the aggregate gradation shall be based on samples taken from the final mix.

9-03.8(3)B GRADATION - RECYCLED ASPHALT PAVEMENT AND MINERAL AGGREGATE

Asphalt concrete planings or old asphalt concrete utilized in the production of asphalt concrete shall be sized prior to entering the mixer so that a uniform and thoroughly mixed asphalt concrete is produced in the mixer. If there is evidence of the old asphalt concrete not breaking down during the heating and mixing of the asphalt concrete, the Engineer may elect to modify the maximum size entering the mixer. No contamination by deleterious Materials will be allowed in the old asphalt concrete used.

The gradation for the new aggregate used in the production of the asphalt concrete shall be the responsibility of the Contractor, and when combined with recycled Material, the combined Material shall meet the gradation Specification requirements for the specified Class ACP as listed in Section 9-03.8(6) *unless the Contract specifies otherwise*. The new aggregate shall meet the general requirements listed in Section 9-03.8(1) and shall meet the appropriate fracture and sand equivalent requirements as listed in Section 9-03.8(2).

9-03.8(4) BLENDING SAND

In the production of aggregate for asphalt concrete, there is often a deficiency of material passing the U.S. No. 40. When this occurs, blending sand in an amount specified by the Engineer may be used to make up this deficiency, provided that an *acceptable* final mix is produced, including fracture requirements.

Blending sand shall be clean, hard, sound material, either naturally occurring sand or crusher fines, and *shall* be Material which readily accepts an asphalt coating. The exact grading requirements for the blending sand shall be such that, when it is mixed with an aggregate, the combined product shall meet the requirements of Section 9-03.8(6) for the class of Material involved. Blending sand shall meet the following quality requirement:

Sand Equivalent	30 min.
-----------------	---------

Blending sand shall be tested by the Materials Laboratory before it may be approved for use.

9-03.8(5) MINERAL FILLER

Mineral filler used in asphalt cement pavement mix shall conform to the requirements of AASHTO M 17.

9-03.8(6) PROPORTIONS OF MATERIALS

The materials of which asphalt concrete is composed shall be of such sizes, gradings, and quantities that, when proportioned and mixed together, produce a well graded mixture within the requirements listed in the tables which follow.

For the determination of a Project mix design, the Contractor shall submit to the Engineer representative samples of the various aggregates to be used along with gradation data showing the stockpile averages and variation of the aggregates as produced together with proposed combining ratios and average gradation of the completed mix. The initial asphalt content shall be determined by the Engineer from the aggregates and data provided.

The percentages of aggregate, including mineral filler, when used, refer to the completed dry mix. The percentage of asphalt refers to the complete asphalt concrete mixture.

Aggregate gradings within the above ranges shall be such that there is a minimum of 2 percent of the total aggregate retained between any successive pair of sieves finer than the U.S. No. 10. The gradings shall be of such uniformity that the fractions of aggregate passing the 1/4 inch and U.S. No. 10 during the Day's run shall conform to the following limitations:

Maximum variation in percentage of Material passing 1/4" square	10%
Maximum variation in percentage of Material passing U.S. No. 10	8%

For asphalt concrete Class A, Class B, Class E, Class F and Class G produced using recycled asphalt Materials, the sand silt requirements and the gradation for the U.S. No. 200 sieve for the asphalt concrete for placement in areas other than the wearing course of traveled lanes are revised as follows:

	U.S. NO. 200 - % Passing	Sand/Silt
50%-60% Recycled Material	3.0 – 8.0%	Waived
61%-70% Recycled Material	3.0 – 9.0%	Waived
71%-100% Recycled Material	3.0 – 10.0%	Waived

ASPHALT CONCRETE GRADING REQUIREMENTS						
Sieve Size	Class A	Class B	Class D	Class E	Class F	Class G
	Percent Passing					
1-1/4" square	---	---	---	100	---	---
1" square	---	---	---	90 – 100	---	---
3/4" square	100	100	---	---	100	---
5/8" square	---	---	---	67 - 86	---	---
1/2" square	90 – 100	90 - 100	100	60 - 80	80 – 100	100
3/8" square	75 – 90	75 - 90	97 - 100	---	---	97 - 100
1/4" square	55 – 75	55 - 75	---	40 - 62	45 – 78	60 - 88
U.S. No. 4	---	---	30 - 50	---	---	---
U.S. No. 8	---	---	5 - 15	---	---	---
U.S. No. 10	30 – 42	30 - 42	---	25 - 40	30 – 50	32 - 53
U.S. No. 40	11 – 24	11 - 24	---	10 - 23	---	11 - 24
U.S. No. 200	3 – 7	3 - 7	2 - 5	2 - 9	2 – 8	3 - 7
Mineral Filler	3.0 - 7.0	3.0 - 7.0	2.0 - 5.0	2.0 - 9.0	2.0 - 8.0	3.0 - 7.0
Asphalt % of total mixture	4.0 - 7.5	4.0 - 7.5	5.5 - 8.5	3.5 - 7	4 – 7	4 - 7.5
Sand-Silt Ratio	5.5 - 10.5	5.5 - 10.5	---	---	---	5.5 - 10.5

9-03.9 AGGREGATES FOR BALLAST AND CRUSHED SURFACING

9-03.9(1) BALLAST

Roadway ballast shall be manufactured from ledge rock or talus obtained from sources approved by the Engineer. Roadway ballast shall meet the requirements of Section 9-03.16 for Mineral Aggregate Type 14.

That portion of roadway ballast retained on a 1/4 inch square sieve shall not contain more than 0.2 % wood Waste.

The Material from which ballast is to be manufactured shall meet the following test requirements:

Los Angeles Wear, 500 Rev	40% max.
Degradation Factor	15 min.
Sand Equivalent	35 min.
Dust ratio	2/3 max.

Mineral Aggregate Type 1 or Type 2 may be substituted for roadway ballast in lieu of Mineral Aggregate Type 14 when specified in the Contract.

Ballast shall be a crushed Material with no naturally occurring surfaces. The term, "ballast" shall apply to Material retained on each sieve size 1/4 inch and above if that sieve retains more than 5 percent of the total sample.

9-03.9(2) SHOULDER BALLAST

Shoulder ballast shall meet the requirements of Section 9-03.9(1) for ballast except the gradation shall meet the requirements of Section 9-03.16 for Mineral Aggregate Type 13. The sand equivalent and dust ratio requirements shall not apply; however, the L. A. Abrasion and Degradation Factor requirements shall apply.

9-03.9(3) CRUSHED SURFACING

Except as otherwise specified in the remainder of this Section, crushed surfacing shall be manufactured from ledge rock or talus and shall meet the grading, Sand Equivalent, and L. A. Abrasion requirements of Section 9-03.16 for Mineral Aggregate Type 1, Type 2, and Type 3.

Crushed surfacing shall be a totally crushed Material with no naturally occurring faces and shall apply to Material retained on each sieve size No. 10 and above if that sieve retains more than 5 percent of the total sample. *Crushed surfacing may be manufactured from gravel if its use meets the requirements set forth in Section 9-03.11 for Mineral Aggregate Type 1G and 2G (see Section 4-04.2 for limitations regarding substituting crushed gravel for crushed rock).*

The portion of crushed surfacing retained on sieves 1/4 inch and larger shall contain less than 0.15 % wood Waste.

9-03.9(4) MAINTENANCE ROCK

Maintenance rock shall meet all requirements of Section 9-03.9(3) for crushed surfacing top course except that it shall meet the following Specifications for grading:

Sieve Size	Percent Passing
1/2" square	100
1/4" square	55 - 70
U.S. No. 40	10 - 25
U.S. No. 200	7 max.

Maintenance rock shall have a maximum 35% L. A. Abrasion (see Section 9-03.16, Mineral Aggregate Type 3).

9-03.9(5) SAND FILLER

Sand filler shall be natural deposit angular grains complying with Mineral Aggregate Type 11 per Section 9-03.16.

9-03.10 AGGREGATE FOR GRAVEL BASE

Gravel base shall meet the requirements of Section 9-03.12(2) for Mineral Aggregate Type 17.

9-03.11 CRUSHED GRAVEL

Crushed gravel shall be manufactured from mechanically crushed clean, washed gravel, and shall meet the grading requirements of Section 9-03.16 for Mineral Aggregate Types 1G, 2G, and 21 through 24. The number of fractured surfaces and the minimum percent of crushed particles required to have the fractured surfaces specified are as follows:

Mineral Aggregate Type	Number of Fractured Surfaces	Minimum Percent Required
1G	2 or more	90%
2G	2 or more	90%
21	1 or more	75%
22	1 or more	75%
23	1 or more	75%
24	2 or more	95%

These fracture requirements shall apply to aggregates retained on all sieves sized 1/4 inch and larger, retaining at least 5 percent of total Mineral Aggregate weight.

Mineral Aggregates Type 1G and Type 2G may be used as Base Course in lieu of a crushed rock Mineral Aggregates Type 1 and Type 2 *only when specified for use in the Contract* and when meeting one or more of the following:

1. Covered and confined with Portland cement concrete pavement; or confined within a trench; and
2. Costs shall be adjusted in accordance with Section 4-04.

Crushed gravel shall not be substituted for crushed rock as a base course for asphalt concrete pavement. Only crushed rock shall be used under asphalt concrete pavement. Crushed gravel is acceptable as a base course only under asphalt concrete pavement overlying Portland cement rigid pavement base.

Crushed gravel and crushed rock shall be substantially free from adherent coatings. The presence of a thin, firmly adhering film of weathered rock shall not be considered as coating unless it exists on more than 50 percent of the surface area of any size between successive laboratory sieves.

The combined portion of Mineral Aggregate retained on all sieves of 1/4 inch openings shall not contain more than 0.1 percent wood Waste by weight. The portion of Material passing a U.S. No. 10 sieve shall not have wood Waste that results in more than 250 parts per million of organic matter by calorimetric tests when tested. The color shall be measured after the sample has been in the test solution for 1 hour.

9-03.12 PIT RUN SAND, WASHED SAND, AND GRAVEL BACKFILL

Gravel backfill shall consist of crushed, partially crushed, or naturally occurring granular Material depending on the Type of Mineral Aggregate specified in the Contract.

9-03.12(1) GRAVEL BACKFILL FOR FOUNDATIONS

9-03.12(1)A CLASS A BACKFILL

Class A gravel backfill for foundations shall meet the requirements of Section 9-03.9 and 9-03.16 for Type 2 or Type 14 Mineral Aggregates. When not specified in the Contract, Class A gravel backfill shall be Mineral Aggregate Type 2.

9-03.12(1)B CLASS B BACKFILL

Class B gravel backfill for foundations shall meet the requirements of Section 9-03.16 for Type 17 Mineral Aggregate.

9-03.12(2) GRAVEL BACKFILL FOR WALLS

Gravel backfill for walls shall consist of free draining sand and gravel from naturally occurring or screened sources; have such characteristics of size and shape that it readily compacts; and meets the requirements of Section 9-03.16 for Mineral Aggregate Type 17.

The combined portion of Material retained on all sieves of 1/4 inch openings and larger, shall contain no more than 0.20 percent by weight of wood Waste.

9-03.12(3) GRAVEL AND SAND BACKFILL FOR PIPE BEDDING

The Contract specified class of Sewer and Storm Drain pipe bedding shall comply with both Standard plan no. 285 and Section 7-17.3(1)B), and shall be Mineral Aggregate Type 9 and Type 22 as specified in this Section and Section 9-03.16.

Water Main distribution pipe bedding Material shall meet the requirements of Section 9-03.16 for Mineral Aggregates Type 6 or Type 7 and Section 9-03.1(2). Water Main transmission pipe bedding shall meet the requirements of Section 9-03.16 for Mineral Aggregate Type 9 as shown on Standard Plan no. 350 and this Section. The bedding Class specified on the Drawings shall be as shown on Standard Plan no. 350.

Pea gravel bedding, Mineral Aggregate Type 9, shall consist of screened sand, gravel, or other inert Materials, or combinations thereof, from sources approved by the Engineer, and shall have hard, strong, durable particles free from adherent coatings. The Material shall be washed thoroughly to remove clay, loam, alkali, organic matter, or other deleterious substances. The amount of deleterious substances remaining in the washed pea gravel shall not exceed values specified in Section 9-03.1(2)B.

Crushed gravel bedding, Mineral Aggregate Type 22 shall be manufactured from screened crushed gravel. The finished product shall be clean, uniform in quality, and free from wood, bark, roots, and other deleterious Materials. The crushed screenings shall be substantially free from adherent coatings. The presence of a thin, firmly adhering film of weathered rock shall not be considered as coating unless it exists on more than 50 percent of the surface area of any size between successive laboratory sieves. The portion of Mineral Aggregate Type 22 retained on all sieves with a 1/4 inch opening and larger shall not contain more than 0.1 percent deleterious Materials by weight.

9-03.12(4) GRAVEL BACKFILL FOR DRAINS

Gravel backfill for drains shall meet the requirements for Mineral Aggregate Type 26 in Section 9-03.16.

9-03.12(5) PIT RUN SAND AND GRAVEL

Pit run sand and gravel shall consist of free draining granular Materials obtained from naturally occurring deposits or manufactured from screened gravel.

Pit run sand shall meet the requirements of Section 9-03.16 for Mineral Aggregate Type 10.

Pit run sandy gravel shall meet the requirements of Section 9-03.16 for Mineral Aggregate Type 15.

9-03.12(6) WASHED SAND AND GRAVEL

Washed sand and gravel shall meet the gradation requirements of Section 9-03.16 for Mineral Aggregate Types 4, 5, 6, 7, and 26, whichever is specified in the Contract.

Washed sand and gravel shall consist of screened sand, gravel or other inert Materials, or combinations thereof, from sources approved by the Engineer, having hard, durable particles free from adherent coatings. The Materials shall be washed thoroughly to remove clay, loam, alkali, organic matter, or other deleterious substances. The amount of deleterious substances in the washed sand or gravel shall not exceed the values specified in Section 9-03.1(2)B for Mineral Aggregate Types 6, 7, and 26 and Section 9-03.1(3)B for Mineral Aggregate Types 4 and 5.

9-03.13 BACKFILL FOR SAND DRAIN**9-03.13(1) SAND DRAIN BACKFILL**

Sand drain backfill shall conform to the following gradation (Note - not a Mineral Aggregate Type in Section 9-03.16):

Sieve Size	Percent Passing
1/2" square	90 - 100
1/4" square	65 - 100
U.S. No. 10	40 - 100
U.S. No. 50	3 - 30
U.S. No. 100	0 - 4
U.S. No. 200	0 - 3.0

9-03.13(2) SAND DRAINAGE BLANKET

Aggregate for the sand drainage blanket shall consist of granular Material, free from wood and other extraneous Material and shall meet the following requirements for grading (*Note – not a Mineral Aggregate Type in Section 9-03.16*):

Sieve Size	Percent Passing
2-1/2" square	90 - 100
1/4" square	30 - 100

The portion passing 1/4" shall meet the following requirements for grading:

Sieve Size	% Passing
U.S. No. 10	50 - 100
U.S. No. 50	0 - 30
U.S. No. 100	0 - 7.0
U.S. No. 200	0 - 3.0

That portion of backfill for sand drains and sand drainage blanket retained on all sieves 1/4 inch openings and larger shall contain not more than 0.05 percent by weight of wood Waste.

9-03.14 GRAVEL BORROW

Unless otherwise specified in the Contract, gravel borrow shall meet the requirements of Section 9-03.12(2) and the grading requirements in Section 9-03.16 for Mineral Aggregate Type 17.

If requested by the Contractor, the screen size may be increased if it is determined by the Engineer that larger size aggregate will be acceptable for the specified backfilling or embankment construction.

9-03.15 TEST METHODS FOR AGGREGATES

Material properties in these Specifications shall be determined in accordance with the following test methods:

Title	Test Method
Sampling	AASHTO T 2
Organic Impurities	WSDOT No. 21
Clay Lumps in Aggregates	AASHTO T 112
Abrasion of Coarse Aggregates by Use of the Los Angeles Machine	AASHTO T 96
Material Finer than U.S. No. 200 Sieve in Aggregates	AASHTO T 11
Sieve Analysis of Fine and Coarse Aggregates	AASHTO T 27
Determination of Degradation Value	WSDOT No. 113
Determination of Fineness Modulus	AASHTO T 27
Lightweight Pieces in Aggregates	WSDOT No. 122
Mortar Strength	WSDOT No. 311
Percentage of Particles Smaller than 0.025 mm and 0.005 mm	AASHTO T 88
Stabilometer R Value, Untreated Materials	WSDOT No. 611
Swell Pressure and Permeability	WSDOT No. 611
Stabilometer S Value, Treated Materials	WSDOT No. 703
Cohesimeter	WSDOT No. 703
Compressive Strength of Concrete	AASHTO T 22
Flexural Strength of Concrete	WSDOT No. 802
Specification for Wire-Cloth Sieves for Testing Purposes	AASHTO M 92

9-03.16 MINERAL AGGREGATE CHART

Commonly used mineral aggregates can be found in the following Mineral Aggregate Chart. The "No." indicated at the top of column 1 is commonly referred to as Mineral Aggregate "Type" number.

Gradation requirements for Mineral Aggregates Type 6 and Type 7 indicated on the following Mineral Aggregate Chart require additional sieves. These Mineral Aggregate Types are noted with a "*" in the first column labeled "No.". See the specified "Standard Specification Section" for these noted additional required sieves.

This Page Intentionally Blank

Sieve Analysis-Percent Passing By Weight

[illegible]

This Page Intentionally Blank

9-03.17 ROCK FACING MATERIAL

Rock for constructing new rock facing shall be large, broken pieces of igneous and metamorphic rock types. Each rock shall be rectangular, intact, *fracture free*, sound and *durable* Material, resistant to weathering and free of soft weathered Material and seams of soft rock susceptible to deterioration.

The size categories for rock shall be as follows:

Size	Approx. Weight	Min. Approx. Dimensions	Approx. Volume
One-man rock	200 – 400 lbs.	12 inches	2 cf
Two-man rock	500 – 800 lbs.	13 inches	4 cf
Three-man rock	900 – 1200 lbs.	16 inches	6.6 cf
Four-man rock	1300 – 2000 lbs.	18 inches	12.5 cf
Five-man rock	2000 – 4000 lbs.	24 inches	18.5 cf
Six-man rock	4100 – 6000 lbs.	30 inches	31 cf

Rocks less than 1.5 cubic foot (cf) in volume shall not be used.

The Contractor shall provide the services of an ASTM or AASHTO accredited testing laboratory approved by the Engineer to sample the rock from the quarry source, ensuring that rock samples are representative of the rock anticipated for use on the Project, and to perform the following laboratory tests:

Specific Gravity	ASTM C-127	Minimum 2.65
Soundness	AASHTO T 104 (section 5.2.2)	Not greater than 5 % loss
Accelerated Expansion	CRD-C-148	Not greater than 15% breakdown
Absorption	ASTM C-127	Not greater than 2%
L.A. Abrasion	ASTM C-131	Maximum 20% loss @ 500 revolutions

All rock to be delivered to and incorporated into the Project where rock facing is over 6 feet high, shall meet the minimum testing requirements noted above; the rock shall be stockpiled in a separate pile at the quarry prior to delivery to the Project Site and shall be protected from contamination with other, untested rock sources.

SECTION 9-04 JOINT AND CRACK SEALING MATERIALS**9-04.1 PREMOLDED JOINT FILLERS****9-04.1(1) FILLER FOR CONTRACTION AND LONGITUDINAL JOINTS IN CONCRETE PAVEMENT**

Premolded joint filler for use in concrete contraction and longitudinal joints shall consist of a suitable asphalt mastic encased in asphalt-saturated paper or asphalt-saturated felt. It shall be sufficiently rigid for easy installation in summer months and not too brittle for handling in cool weather. It shall meet the following test requirements:

When a strip 2 inches wide and 24 inches long is freely supported 2 inches from each end and maintained at a temperature of 70°F, it shall support a weight of 100 grams placed at the center of the strip without deflecting downward from a horizontal position more than 2 inches within a period of 5 minutes.

The thickness and width of joint filler shall be as shown in the Standard Plans unless the Contract specifies otherwise. Where no premolded joint filler thickness is indicated, the premolded filler thickness shall be 3/8 inch.

9-04.1(2) FILLER FOR THROUGH, CONSTRUCTION, AND EXPANSION JOINTS IN CONCRETE PAVEMENT

Premolded joint filler for expansion or through joint applications shall conform to the specifications for "Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction", AASHTO M 213, except the requirement for water absorption is not applicable. The thickness and width of premolded joint filler for expansion, through, and construction joints shall be as indicated on the Standard Plans unless otherwise specified in the Contract. Where no premolded filler thickness is indicated, the thickness shall be 3/4 inch.

9-04.1(3) RESERVED**9-04.1(4) ELASTOMERIC EXPANSION JOINT SEALS**

Premolded elastomeric expansion joint seals shall conform to the requirements of AASHTO M 220 and shall be formed by an extrusion process with uniform dimensions and smooth exterior surfaces. The cross-section of the seal shall be shaped to allow adequate compressed width of the seal, as approved by the Engineer.

9-04.2 JOINT SEALANTS**9-04.2(1) JOINT SEALANTS FOR SAWED CONTRACTION JOINTS**

Joint sealants for sawed contraction joints shall meet the requirements of one of the following types: (1) AASHTO M 173, Concrete Joint Sealer, Hot Poured Elastic Type, or (2) ASTM D 1120, Concrete Joint Sealer, Cold Application Type; except that the test for evaluation of the bond requirements in each of the above requirements shall be in accordance with the bond test methods referred to in Section 9-04.2(2). Unless otherwise stated in the Contract, the Contractor shall have the option of using either of the above two types.

9-04.2(2) POURED JOINT SEALER FOR PAVEMENT AREAS

The physical properties of the joint sealer, when mixed in accordance with the manufacturer's recommendations, shall be as follows:

1. Color: Gray or black.
2. *Viscosity: *Shall* be pourable and self-leveling at 50°F.
3. *Application Life: Not less than 3 hours at 72°F and 50 percent relative humidity.
4. Set to Touch: Not more than 24 hours at 72°F and 50 percent relative humidity.
5. Curing Time: Not more than 96 hours at 72°F and 50 percent relative humidity.
6. Non-Volatile Content: Not less than 92 percent.
7. Hardness Rating (Durometer "Shore A"): 5-35.
8. Resiliency: Not less than 80 percent.
9. Bond test methods shall be in accordance with WSDOT Test Method No. 412A.

*Viscosity and application life may be waived providing the Material is mixed and placed by a pump and mixer approved by the Engineer, or if the Contract requires fast cure.

Suitable primer, if required by the manufacturer, shall be furnished with each joint sealer. The primer shall be suitable for brush or spray application at 50°F or higher and shall cure sufficiently at 50°F to pour the joint within 24 hours. It shall be considered as an integral part of the sealer system. Any failure of the sealer in the test described herein, attributable to the primer, shall be grounds for rejection of the sealer.

Acceptance of joint sealing compound for use on a Project shall be on the basis of Laboratory tests of samples representative of each batch of Material to be used on the job. A period of at least two weeks shall be allowed for completion of these tests. Each container of the compound shall be clearly identified as to manufacturer and batch number.

9-04.2(3) POURED JOINT SEALER FOR WALKWAYS

Poured joint sealer used to seal sawed joints in sidewalks, stairs, plazas, and other walkways shall be a polyurethane sealer conforming to Federal Specification TT-S-00227E Type I (self-leveling) Class A or Type II (non-sag) Class A.

9-04.3 MORTAR AND NON-SHRINK CEMENT SAND GROUT**9-04.3(1) JOINT MORTAR**

Mortar shall be produced using Type II or III *Portland* cement, fine aggregate Class 1 or Class 2 (see Section 9-03.1(2)), and water in proportion applicable to the application. Generally the proportions are one part *Portland* cement to two or three parts fine aggregate with just enough water to make a stiff consistency. The mortar mix shall be approved by the Engineer before use.

9-04.3(2) NON-SHRINK CEMENT SAND GROUT**9-04.3(2)A GENERAL**

The grout shall be covered with burlap sacks after the initial concrete set, promptly wetted, and maintained continuously moist until the required strength is obtained. See Section 6-02.3(3)D for surface preparation, application, and curing.

9-04.3(2)B GROUT FOR ANCHOR BOLTS, BRIDGE BEARINGS, AND DRAINAGE STRUCTURE

*Non-shrink cement sand grout used for grouting anchor bolts and bridge bearings, and for use in drainage Structures other than pipe connections, may be a prepackaged grout, or produced using Type I, II, or III *Portland* cement; fine aggregate Class 1 or Class 2 (see Section 9-03.1(2)); and sufficient water to make a workable mix with flowability suitable for the intended application. Compressive strength shall be a minimum 4000 psi @ 3 Days.*

9-04.3(2)C GROUT FOR PIPE CONNECTIONS AND POLES & PEDESTALS

Non-shrink cement sand grout for pipe connections to manholes, catch basins, inlets, and similar utility appurtenances; installing tees; grouting under poles and pedestals; and similar uses shall meet the following requirements:

1. 1-part, by weight, Type III (H.E.S.) cement;
2. 2-parts, by weight, clean fine aggregate Class 1 or Class 2 (see Section 9-03.1(2)); and

3. Sufficient water complying with Section 9-25.1 to obtain a stiff consistency. The use of calcium chloride will not be allowed.

Unpolished aluminum powder shall be added to the dry cement in the proportion of one heaping teaspoonful per sack of cement no more than 30 minutes before the grout mixture reaches its final in-place position. *The required compressive strength shall be a minimum 4,000 psi @ 7 Days.*

9-04.3(2)D GROUT FOR TENDONS

Non-shrink cement sand grout used for grouting tendons shall be as specified in Section 6-02.3(26)G. Compressive strength shall be determined by fabricating cubes per WSDOT Method 813 and testing their compressive strength per AASHTO T 106.

The strength shall be confirmed by Schmidt hammering of the pads.

9-04.4 RUBBER GASKETS

9-04.4(1) RUBBER GASKETS FOR CONCRETE PIPES AND PRECAST MANHOLES

Rubber gaskets for use in joints of concrete Culvert or storm Sewer pipe and precast manhole sections shall conform to the applicable requirements of ASTM C 443.

9-04.4(2) RESERVED

9-04.4(3) RUBBER GASKETS FOR ALUMINUM OR STEEL CULVERT OR STORM SEWER PIPE

Gaskets for use with metal Culvert or storm Sewer pipe shall be continuous closed cell, synthetic expanded rubber gaskets conforming to the requirements of ASTM D 1056, Grade 2B3.

9-04.4(4) RUBBER GASKETS FOR ALUMINUM OR STEEL DRAIN PIPE

Gaskets for metal drain pipe shall be self-adhering, butyl-based scrim-supported type. When specified, the gaskets shall be as described in the Standard Plans.

9-04.4(5) PROTECTION AND STORAGE

Rubber gasket Material shall be stored in a clean, cool place, protected from contaminants. They shall be protected from direct sunlight at all times except during actual installation. Pipes with gaskets affixed shall be installed in the line within 28 Days of date of delivery from the manufacturer. Rubber gaskets found on-site more than 28 Days after delivery from the manufacturer will be rejected. The Contractor shall submit an invoice from the manufacturer stating date of delivery.

9-04.5 FLEXIBLE PLASTIC GASKETS

The gasket Material shall be produced from blends of refined hydrocarbon resins and plasticizing materials reinforced with inert mineral filler and shall contain no solvents. It shall not depend on oxidizing, evaporating, or chemical action for adhesive or cohesive strength. It shall be supplied in extruded rope-form of such cross-section and size as to adequately fill spaces between the precast sections.

The gasket Material shall be protected by a suitable removable two piece wrapper so designed as to permit removing one half, longitudinally, without disturbing the other. Its composition and properties shall conform to those set forth as follows:

	Test Method	Minimum	Maximum
Bitumen (Petroleum plastic content)	ASTM D 4	50	70
Ash-inert Mineral Matter	AASHTO T 11	30	50
Penetration	ASTM D 217		
32°F (300gm) 60 sec		75	---
77°F (150gm) 5 sec		50	120
115°F (150gm) 5 sec		---	150
Softening Point	ASTM D 36	320°F	---
Specific Gravity at 77°F	ASTM D 71	1.20	1.35
Weight per gallon, lb.		10.0	11.3
Ductility at 77°F (cm)	ASTM D 113	5.0	---
Flash Point COC, °F	ASTM D 93	600	---
Fire Point COC, °F	ASTM D 92	625	---
Volatile Matter	ASTM D 6	---	2.0

9-04.6 EXPANDED POLYSTYRENE

Expanded polystyrene shall be of a cellular molded type with a density of 1.5 ± 0.25 pounds per cubic foot.

9-04.7 EXPANDED RUBBER

Closed cell expanded rubber joint filler shall conform to ASTM D 1056, Grade No. 2B3.

9-04.8 FLEXIBLE ELASTOMERIC SEALS

Flexible elastomeric seals for PVC drain pipe and FOR underdrain pipe shall conform to ASTM D 3212.

9-04.9 SOLVENT CEMENTS

Solvent Cements for PVC underdrain pipe shall conform to the requirements of ASTM D 2564.

9-04.10 CRACK SEALING - RUBBERIZED ASPHALT

Rubberized asphalt for crack sealing asphalt concrete pavement shall conform to AASHTO M 173 (ASTM D 1190) and have a COC flash point (AASHTO T 48) of 400°F minimum. AASHTO M 173 (ASTM D 1190) is modified to delete the Bond Test requirement. AASHTO T 48 is modified to require careful agitation of the rubberized asphalt sample during testing to prevent local overheating.

SECTION 9-05 STORM DRAIN AND SANITARY SEWER STRUCTURES, CULVERTS, AND CONDUITS**9-05.0 ACCEPTANCE BY MANUFACTURER'S CERTIFICATION**

Certain drainage Materials may be accepted by the Engineer based on a Manufacturer's Certificate of Compliance meeting the requirements of Section 1-06.3. These Materials are as follows:

- Metal drain and underdrain pipe,
- PVC and corrugated polyethylene drain pipe and underdrain pipe,
- Metal Culvert, Storm Drain pipe and pipe arch less than 30 inches in diameter,
- Metal Culvert end sections,
- Corrugated metal structural plate pipe, pipe arch, and under passes, and
- Ductile iron pipe.

9-05.1 DRAIN PIPE**9-05.1(1) CONCRETE DRAIN PIPE**

Concrete drain pipe shall be manufactured by plants certified by the National Precast Concrete Association (NPCA) or approved equal. The pipe shall meet the requirements of ASTM C 14 Class 3 for pipe less than 12 inches in diameter; ASTM C 76 Class IV wall B for 12 and 15 inch diameter pipe; and ASTM C 76 Class III wall B for pipe 18 inches in diameter and larger. Exceptions may be specified in the Contract.

For concrete pipe 27 inch in diameter or less, a Manufacturer's Certificate of Compliance indicating applicable items of this Specification shall be submitted to the Engineer at the time of delivery. The Engineer reserve the right to reject pipe that does not meet requirements in Section 9-05.1(1).

For concrete pipe over 27 inch in diameter, the Contractor shall provide the Engineer a minimum 15 Working Days advance notice for inspection during pipe production and prior to shipping by the Materials Laboratory or it's designated representative.

9-05.1(2) ZINC COATED (GALVANIZED) OR ALUMINUM COATED (ALUMINIZED) CORRUGATED IRON OR STEEL DRAIN PIPE**9-05.1(2)A GENERAL**

Zinc coated (galvanized) or aluminum coated (aluminized) corrugated iron or steel drain pipe shall meet the requirements of AASHTO M 36. The galvanized or aluminized sheet thickness shall be 0.052 inch for 6 inch diameter drain pipe and 0.064 inch for 8 inch diameter and larger drain pipe. Welded seam aluminum coated (aluminized) corrugated iron or steel drain pipe with metallized coating applied inside and out following welding is acceptable.

See Section 7-16.2 for restrictions on the use of corrugated metal pipe flow control systems and detention systems in landslide-prone areas, and for pipe to be maintained by the City in landslide-prone areas.

9-05.1(2)B COUPLING BANDS

Coupling bands for zinc coated (galvanized) or aluminum coated (aluminized) corrugated iron or steel drain pipe shall meet the requirements of coupling bands for Type I pipe of AASHTO M 36, except that bands using projections (dimples) shall not be permitted. The bands shall be fabricated of the same Material as the pipe, and with the same metallic protective treatment as the pipe.

Acceptable coupling bands for corrugated metal pipe shall be made using a 2-piece, 24 inch wide corrugated coupling band, held together with angles and bolts, a neoprene gasket between the pipe and the band, be of the same Material and corrugations as the pipe, and meet the requirements of Section 9-05.4(7).

9-05.1(3) CORRUGATED ALUMINUM DRAIN PIPE**9-05.1(3)A GENERAL**

Corrugated aluminum drain pipe shall meet the requirements of AASHTO M 196, without perforations. See Section 7-16.2 for restrictions on the use of corrugated metal pipe flow control systems and detention systems in landslide-prone areas, and for pipe to be maintained by the City in landslide-prone areas.

9-05.1(3)B COUPLING BANDS

Coupling bands for corrugated aluminum alloy drain pipe shall meet the requirements of coupling bands for Type I pipe of AASHTO M 196, except that bands using projections (dimples) shall not be permitted. The bands shall be fabricated of the same Material as the pipe.

Coupling bands for aluminum corrugated pipe shall be 24 inch, two-piece half-circle corrugated pipe held together with angles and bolts. A neoprene gasket shall be placed between the pipe and the bands. The bands shall be made of the same Material and have the same corrugations as the pipe, and shall meet the requirements of Section 9-05.5(5).

9-05.1(4) GALVANIZED STEEL DRAIN PIPE

Galvanized steel pipe shall be 4 inch inside diameter, Schedule 40 pipe meeting the requirements of ASTM A 53.

9-05.1(5) POLYVINYL CHLORIDE (PVC) DRAIN PIPE

Polyvinyl Chloride drain pipe and fittings shall meet the requirements of ASTM D3034, SDR35 with restrained gasket joints, unless otherwise indicated in the Contract.

9-05.1(6) CORRUGATED POLYETHYLENE DRAINAGE TUBING DRAIN PIPE

Corrugated polyethylene drainage tubing drain pipe shall meet the requirements of AASHTO M 252. The maximum size pipe allowed shall be not larger than 10 inches in diameter.

9-05.1(7) CORRUGATED POLYETHYLENE DRAIN PIPE

Corrugated polyethylene drain pipe shall meet the requirements of AASHTO M 294, Type S. The size of pipe allowed shall range from a minimum 12 inch diameter through and including a maximum 36 inch diameter.

9-05.2 SUBSURFACE DRAIN PIPE**9-05.2(1) RESERVED****9-05.2(2) PERFORATED CONCRETE SUBSURFACE DRAIN PIPE**

Perforated concrete subsurface drain pipe shall meet the requirements of AASHTO M 175, Type I, except that the perforations shall be approximately 1/2 inch in diameter. Strength requirements shall be as shown in Table I of AASHTO M 86.

9-05.2(3) RESERVED**9-05.2(4) ZINC COATED (GALVANIZED) OR ALUMINUM COATED (ALUMINIZED) CORRUGATED IRON OR STEEL SUBSURFACE DRAIN PIPE****9-05.2(4)A GENERAL**

Zinc coated (galvanized) or aluminum coated (aluminized) corrugated iron or steel subsurface drain pipe shall meet the requirements of AASHTO M 36, except that perforations required in Class I, Class II, and Class III pipe may be located anywhere on the tangent of the corrugations provided the other perforation spacing requirements remain as specified. Welded seam aluminum coated (aluminized) corrugated iron or steel subsurface drain pipe with metallized coating applied inside and out following welding is acceptable.

The pipe may conform to any one of the Type III pipes specified in AASHTO M 36, and perforations in Class I, Class II, and Class III pipe may be drilled or punched. The galvanized or aluminized sheet thickness shall be 0.052 inch for 6 inch diameter subsurface drain pipe and 0.064 inch for 8 inch and larger diameter subsurface drain pipe.

See Section 7-16.2 for restrictions on the use of corrugated metal pipe flow control systems and detention systems in landslide-prone areas, and for pipe to be maintained by the City in landslide-prone areas.

9-05.2(4)B COUPLING BANDS

Coupling bands for zinc coated (galvanized) or aluminum coated (aluminized) corrugated iron or steel subsurface drain pipe shall meet the requirements of coupling bands for Type III pipe of AASHTO M 36. The bands shall be fabricated of the same Material as the pipe and with the same metallic protective treatment as the pipe, if metallic bands are used.

Acceptable coupling bands are the two-piece, helically-corrugated band, with nonreformed ends and integrally formed flanges, universal bands (dimple bands), a smooth sleeve-type coupler, and those bands meeting the requirements of Section

9-05.4(7). Smooth sleeve-type couplers may be either plastic or steel suitable for holding the pipe firmly in alignment without the use of sealing compound or gaskets.

9-05.2(5) PERFORATED CORRUGATED ALUMINUM SUBSURFACE DRAIN PIPE

9-05.2(5)A GENERAL

Perforated corrugated aluminum subsurface drain pipe shall meet the requirements of AASHTO M 196, except that the perforations may be located anywhere on the tangent of the corrugations providing the other perforation spacing requirements remain as specified.

See Section 7-16.2 for restrictions on the use of corrugated metal pipe flow control systems and detention systems in landslide-prone areas, and for pipe to be maintained by the City in landslide-prone areas.

9-05.2(5)B COUPLING BANDS

Coupling bands for corrugated aluminum subsurface drain pipe shall meet the requirements of coupling bands for Type III pipe of AASHTO M 196. The bands shall be fabricated of the same Material as the pipe, if metallic bands are used.

Acceptable coupling bands are two-piece, helically-corrugated with nonreformed ends and integrally formed flanges; universal bands (dimple bands); a smooth sleeve-type coupler; and those bands meeting the requirements of Section 9-05.5(5). Smooth sleeve-type couplers may be either plastic or aluminum, suitable for holding the pipe firmly in alignment without the use of sealing compound or gaskets.

9-05.2(6) PERFORATED PVC SUBSURFACE DRAIN PIPE

Perforated PVC subsurface drain pipe shall meet the requirements of AASHTO M 278. Pipe size shall not exceed 8 inch diameter unless indicated otherwise in the Contract.

9-05.2(7) PERFORATED CORRUGATED POLYETHYLENE DRAINAGE TUBING SUBSURFACE DRAIN PIPE

Perforated corrugated polyethylene drainage tubing subsurface drain pipe shall meet the requirements of AASHTO M 252. The maximum size pipe shall be 8 inches in diameter.

9-05.2(8) PERFORATED CORRUGATED POLYETHYLENE SUBSURFACE DRAIN PIPE

Perforated corrugated polyethylene subsurface drain pipe, 12 inch through 24 inch diameter, shall meet the minimum requirements of AASHTO M 294. Perforations shall be in accordance with AASHTO M 252.

9-05.3 CONCRETE CULVERT PIPE

9-05.3(1) PLAIN CONCRETE CULVERT PIPE

9-05.3(1)A GENERAL

Plain concrete Culvert pipe shall be manufactured by a plant certified by the National Precast Concrete Association (NPCA) or approved equal and shall meet the requirements of ASTM C 14, Class 2.

9-05.3(1)B END DESIGN

The end designs for plain concrete Culvert pipe shall conform to the applicable requirements of AASHTO M 198 when rubber gasketed joints are required. Unless specified otherwise in the Contract, the Contractor shall have the option of providing rubber gasket or cement mortar joints. The planes of the ends of the pipes shall be perpendicular to their longitudinal axes.

9-05.3(1)C BASIS FOR ACCEPTANCE

The basis for acceptance of plain concrete Culvert or drain pipe will be based on a Manufacturer's Certificate of Compliance indicating acceptable results of three edge bearing tests performed at the manufacturer's plant within the 90-Day period immediately preceding shipment of the pipe.

9-05.3(1)D AGE AT SHIPMENT

Plain concrete Culvert pipe may be shipped when it meets all test requirements. Unless it is tested and accepted at an earlier age, it shall not be considered ready for shipment sooner than 28 Days after manufacture when made with Type II Portland cement, nor sooner than 7 Days when made with Type III Portland cement.

9-05.3(2) REINFORCED CONCRETE CULVERT PIPE

9-05.3(2)A GENERAL

Reinforcing concrete Culvert pipe shall be manufactured by a plant certified by National Precast Concrete Association (NPCA) or approved equal and shall conform to the requirements of ASTM C76, Class III.

9-05.3(2)B END DESIGN

Section 9-05.3(1)B will apply to reinforced concrete Culvert pipe.

9-05.3(2)C BASIS FOR ACCEPTANCE

The basis for acceptance of reinforced concrete pipe 60 inches in diameter and smaller will be determined by the results of the **three edge bearing test** for the load to produce a 0.01 inch crack, and testing to the ultimate load will ordinarily not be required, except as necessary to obtain samples for making the absorption test. In lieu of broken pieces of pipe obtained as above provided, 4 inch diameter cores from pipe sections selected by the Engineer shall be furnished to the Engineer for performing the ASTM C 497 absorption test. Sections of pipe which have been tested to the actual 0.01 inch crack limitation will ordinarily not be further load tested; and such sections which meet or exceed the required strength and workmanship standards may be accepted for use on the Project.

Acceptance of reinforced concrete pipe larger than 60 inches diameter will be based on inspection of the size and placement of the reinforcing steel, and, at the option of the Engineer, on compressive strength tests of 4 inch diameter cores cut from the pipe, or on compressive strength of representative test cylinders cast with and cured with the pipe.

9-05.3(2)D AGE AT SHIPMENT

Reinforced concrete Culvert pipe may be shipped when it meets the requirements of Section 9-05.3(1)D.

9-05.3(3) BEVELED CONCRETE END SECTIONS

Beveled concrete end sections shall be plain concrete conforming to AASHTO M 86 or reinforced concrete conforming to the applicable sections of AASHTO M 170 with the design requirements as listed in Table 2, Wall B, Circular Reinforcement in circular pipe, and WSDOT Standard Plan no. B-7a.

9-05.4 STEEL CULVERT PIPE AND PIPE ARCH**9-05.4(1) GENERAL**

Steel Culvert pipe and pipe arch shall meet the requirements of AASHTO M 36, Type I and Type II. Welded seam aluminum coated (aluminized) corrugated steel pipe and pipe arch with metallized coating applied inside and out following welding is acceptable.

See Section 7-16.2 for restrictions on the use of corrugated metal pipe flow control systems and detention systems in landslide-prone areas, and for pipe to be maintained by the City in landslide-prone areas.

9-05.4(2) ELLIPTICAL FABRICATION

When elongated pipes are specified, circular pipes shall be fabricated 5 percent out of round to form an elliptical section. The vertical or longer axis of the elliptical section shall be clearly marked before shipping.

9-05.4(3) RESERVED**9-05.4(4) ASPHALT COATINGS AND PAVED INVERTS**

Asphalt for asphalt coatings and paved inverts shall meet the requirements of AASHTO M 190, Section 4. The coatings for Treatments 1, 2, and 5 as specified in Section 7-02.3(1)C3a shall be uniform, inside and out, and applied in accordance with the following requirements:

The metal shall be free from grease, dirt, dust, moisture, or other deleterious contaminants. *Either process described as follows may be used for the asphalt coating application:*

1. **Pipe Not Preheated:** The temperature of the asphalt at the time of pipe immersion shall be 400°F (± 5 F°), and the duration of the immersion shall conform to the following schedule:

Thickness in Inches		Minimum Immersion Time-Minutes
Steel	Aluminum	
.064	.060	2.5
.079	.075	3.0
.109	.105	5.0
.138	.135	6.5
.168	.164	8.0

2. **Pipe Preheated:** The asphalt shall have a temperature of 380°F (± 5 F°), and the pipe shall be brought to a temperature of 300°F to 350°F before immersion.

Paved inverts for Treatments 2 and 4 as specified in Section 7-02.3(1)C3a shall consist of bituminous Material applied in such a manner that one or more smooth pavements are formed in the invert filling the corrugations for at least 40 percent of the circumference. The pavement shall have a minimum thickness of 1/8 inch above the crest of the corrugations

except where the upper edges intercept the corrugation. The pavements shall be applied following the coating with asphalt or fiber bonding.

Treatment 5 may be substituted for Treatment 2, and Treatment 6 for Treatment 4 at the option of the Contractor.

9-05.4(5) RESERVED

9-05.4(6) SPUN ASPHALT LINING

Asphalt for spun linings over 100 percent periphery shall conform to AASHTO M 190, Section 4. Asphalt spun linings shall provide a smooth surface for the full interior of the pipe by completely filling the corrugations to a minimum thickness of 1/8 inch above the crests. The interior lining shall be applied by centrifugal or other approved methods. The interior shall be free from sags or runs, but slight residual corrugations due to cooling shrinkage of the lining will not be cause for rejection. At the three-sheet laps, an interior nonuniformity equal to the thickness of the sheet is allowable. The thickness of the lining shall be maintained to the ends of the pipe.

The thickness of the lining over the crest of the corrugation shall not vary by an amount in excess of 1/2 inch over the entire area of the spun lining.

In the case of helical corrugated pipe manufactured with a continuous lock seam, an interior nonuniformity over the lock seam equal to the thickness of two Culvert sheets is allowable.

9-05.4(7) COUPLING BANDS

Coupling bands shall be flange bands or corrugated bands as shown on the Drawings or WSDOT Standard Plan nos. B-13a through B-14 and shall be fabricated of the same Material as the pipe and with the same metallic protective treatment as the pipe. The corrugated bands shall conform to the pipe and shall meet all applicable requirements of AASHTO M 36 except that coupling bands for all sizes of steel pipe arch with 3 inch x 1 inch corrugations shall be 24 inches wide. Bands having projections in lieu of corrugations will not be allowed.

Steel bolts and nuts for coupling bands shall meet the requirements of ASTM A 307 and shall be galvanized in accordance with ASTM A 153.

Steel angles, when required for coupling bands, shall meet the requirements of AASHTO M 36.

Asphalt coating shall not be used on coupling bands.

Coupling bands meeting the requirements of Section 9-05.10(2) shall also be acceptable.

Coupling bands shall be made by the same manufacturer as the steel pipe selected for installation.

9-05.4(8) STEEL CULVERT PIPE ARCH

Steel pipe arch shall meet the requirements for steel pipe and pipe arch of these Specifications except in the method of fabrication. Circular pipe shall be fabricated in two semi-circles, and the pipe arch shall be fabricated in two separate sections, the upper portion or arch, and the bottom section including the connecting arcs.

Both longitudinal edges of the lower section of the pipe arch shall be notched to provide interlocking seams which form the two segments into the full section when it is erected in the field. Hook and eye bolts, or other approved means, shall be provided to hold the segments firmly together.

Individual plates shall be a minimum of 2 feet in length except for short or half sections required to complete the end section of the Culvert.

When protective treatment is specified on the Drawings, pipe arch shall be coated with one of the treatments as provided in Section 7-02.3(1)C3a.

9-05.4(9) STEEL END SECTIONS

9-05.4(9)A GENERAL

The applicable provisions of AASHTO M 36 shall apply to the construction of steel end sections, except that the end sections shall be fabricated of the same Material with the same metallic protective treatment as the pipe.

Asphalt coating shall not be used on steel end sections.

9-05.4(9)B FABRICATION

The shape, thickness, dimensions, and number of pieces shall conform to WSDOT Standard Plan no. B-9 for the size and shape of pipe shown on the Drawings. They shall be manufactured as integral units or so formed that they can be readily assembled and erected in place. When bolts are used for assembly, they shall be 3/8 inch diameter or larger and shall be galvanized. No field welding or riveting shall be permitted.

9-05.4(9)C GALVANIZED HARDWARE

Bolts, nuts, and miscellaneous hardware shall be galvanized in accordance with the provisions of AASHTO M 232.

9-05.4(9)D TOE PLATE EXTENSIONS

Toe plate extensions shall be furnished only when so designated on the Drawings. When required, the toe plate extensions shall be punched with holes to match those in the lip of the skirt and fastened with 3/8 inch or larger galvanized nuts and bolts. Toe plate extensions shall be the same Material and thickness as the end section and shall be fabricated of the same Material with the same metallic protective treatment as the end section.

9-05.5 ALUMINUM CULVERT PIPE

Aluminum Culvert pipe shall conform to the applicable requirements of AASHTO M 196.

9-05.5(1) ELLIPTICAL FABRICATION

Section 9-05.4(2) shall apply to aluminum culvert pipes.

See Section 7-16.2 for restrictions on the use of corrugated metal pipe flow control systems and detention systems in landslide-prone areas, and for pipe to be maintained by the City in landslide-prone areas.

9-05.5(2) MITERED ENDS

Section 7-02.3(1)C2c shall apply to aluminum pipes.

9-05.5(3) PROTECTIVE TREATMENT

When protective treatment is specified for aluminum pipe, it shall be Treatment 5 as shown in Section 7-02.3(1)C3a.

9-05.5(4) ASPHALT COATINGS

Asphalt coatings for aluminum Culvert pipe shall meet the requirements of Section 9-05.4(4).

9-05.5(5) COUPLING BANDS

Coupling bands shall meet applicable requirements of AASHTO M 196. Bands having projections in lieu of corrugations will not be allowed.

Steel bolts and nuts for coupling bands shall meet the requirements of ASTM A 307 and shall be galvanized in accordance with AASHTO M 232 or AASHTO B 633.

Aluminum angles shall be of the same Material as the coupling bands.

Rods, when required, shall meet the requirements of ASTM B 221, Alloy 6061-T6.

Asphalt coating shall not be used on coupling bands.

Coupling bands shall be made by the same manufacturer as the aluminum pipe selected for installation.

9-05.5(6) ALUMINUM END SECTIONS

The applicable provisions of AASHTO M 196 shall apply to the construction of end sections and toe plate extensions for aluminum pipes. In addition, they shall conform to the requirements of Section 9-05.4(9).

Asphalt coating shall not be used on aluminum end sections.

9-05.6 STRUCTURAL PLATE PIPE, PIPE ARCH, ARCH, AND UNDERPASS**9-05.6(1) GENERAL**

Structural plate pipes shall be full circle of the type, gage or thickness, and diameter specified.

Structural plate pipe arches shall be a multi-centered shape, made up of four circular arcs tangent to each other at their junctions and symmetrical about the vertical axis, and of the type, gage or thickness, and span specified.

Structural plate arches shall be a single-centered circular arc shape placed on a reinforced concrete foundation, and of the design, type, gage or thickness, and span as provided for on the Drawings.

Structural plate underpasses shall be a multi-centered shape, made up of a variable number of circular arcs tangent to each other at their junctions and symmetrical about the vertical axis, and of the design, type, gage or thickness, and span specified.

See Section 7-16.2 for restrictions on the use of corrugated metal pipe flow control systems and detention systems in landslide-prone areas, and for pipe to be maintained by the City in landslide-prone areas.

9-05.6(2) FABRICATION

The plates at longitudinal and circumferential seams shall be connected by bolts; the bolt holes shall be staggered in rows 2 inches apart, one hole being punched in the valley and one in the crest of each corrugation along both edges of each plate. Bolt holes on circumferential seams shall be spaced at approximate 12 inch intervals. No hole shall be closer to the edge of the plate than twice the diameter of the bolt.

The ends of structural plate pipes, pipe arches, arches, or underpasses shall not be mitered unless called for in the Contract. If mitered ends are specified, the slope shall conform to the slope of the embankment in which the Culvert is to be placed. The miter on pipe arches shall be limited to the top arc only.

9-05.6(3) ELLIPTICAL FABRICATION

When elongated structural plate pipes are specified, they shall be fabricated 5 percent out of round to form an elliptical cross section. The vertical axis (the longer axis of the elliptical section) shall be clearly marked on the plates before shipping.

9-05.6(4) STRUCTURAL PLATE PIPE ARCH

Plates for structural plate pipe arches shall be formed so that the top shall be an arc of not more than 180 degrees nor less than 155 degrees; the bottom shall be an arc of not more than 50 degrees nor less than 10 degrees; and the top shall be joined at each end to the bottom by an arc having a radius between 18 and 31 inches and of not more than 87-1/2 degrees nor less than 75 degrees.

9-05.6(5) STRUCTURAL PLATE ARCH

Structural plate arches and their foundations shall be as shown on the Drawings.

9-05.6(6) STRUCTURAL PLATE UNDERPASS

Structural plate underpasses shall be as provided for in WSDOT Standard Plan nos. B-8 and B-8a, or, in the case of a special design, as provided for on the Drawings.

9-05.6(7) CONCRETE FOR STRUCTURAL PLATE AND ARCH FOUNDATION

Concrete required for constructing structural plate arch foundations shall be Class B concrete in conformance with the requirements of Section 6-02.3.

Steel reinforcing bars shall conform to the requirements of Section 9-07.1.

9-05.6(8) PLATES**9-05.6(8)A CORRUGATED STEEL PLATES**

Galvanized corrugated steel plates for constructing structural plate pipe, pipe arches, arches, and underpasses, and nuts and bolts used in their assembly shall conform to the requirements of AASHTO M 167 except that the minimum mass of spelter coating on the plates shall be 3 ounces of zinc per square foot of double exposed surface. If the average spelter coating as determined from the required samples is less than 3.0 ounces, or if any one specimen shows less than 2.7 ounces, the lot samples will be rejected. Nuts, bolts, and miscellaneous hardware shall be galvanized in accordance with AASHTO M 232.

See Section 7-16.2 for restrictions on the use of corrugated metal pipe flow control systems and detention systems in landslide-prone areas, and for pipe to be maintained by the City in landslide-prone areas.

9-05.6(8)B CORRUGATED ALUMINUM PLATES

Aluminum alloy plates and fasteners intended for use in the construction of structural plate pipe, pipe arches, arches, and underpasses shall conform to the requirements of AASHTO M 219. Nuts, bolts, and miscellaneous hardware shall be galvanized in accordance with AASHTO M 232.

See Section 7-16.2 for restrictions on the use of corrugated metal pipe flow control systems and detention systems in landslide-prone areas, and for pipe to be maintained by the City in landslide-prone areas.

9-05.7 CONCRETE PIPE**9-05.7(1) PLAIN CONCRETE PIPE****9-05.7(1)A GENERAL**

Plain concrete pipe shall be manufactured by a plant certified by the National Precast Concrete Association (NPCA) or approved equal and shall meet the requirements of ASTM C 14, Class 3.

Permeability test shall be conducted as follows:

The pipe selected for test shall be placed either end down on a soft rubber pad, at the option of the Engineer, and filled with water. The pipe shall be kept full of water for a period of 2 minutes. At the end of that period the outer surface of the pipe shall be examined for leaks.

A leak is herein defined as a moist spot on which, when wiped dry with a cloth, moisture quickly reappears.

The Engineer may test up to 2 percent of all sections in a pipe size but in no case less than 5 sections.

9-05.7(1)B BASIS FOR ACCEPTANCE

The basis for acceptance of plain concrete Sewer pipe will be the same as specified in Section 9-05.3(1)C.

9-05.7(2) REINFORCED CONCRETE PIPE

Reinforced concrete pipe shall be manufactured by a plant certified by the National Precast Concrete Association (NPCA) or approved equal, shall conform to ASTM C 76, and shall be of the class specified in the Contract.

Pipe ends of reinforced concrete pipe may be bell and spigot, modified bell and spigot, or tongue and groove unless otherwise specified in the Contract.

Acceptance will be based on load bearing tests, Material tests, absorption tests in accordance with ASTM C 497, and inspection of the product at any stage of manufacture. Acceptance by cylinders or cores instead of load bearing tests is permissible when agreed upon by the manufacturer and the Engineer at least 5 Working Days prior to manufacture.

Both bells and spigots shall be reinforced in pipe 30 inches or more in diameter.

The identification of the minor axis of elliptical reinforcement shall be in accordance to Section 7-02.3(1)B4.

9-05.7(3) CONCRETE PIPE JOINTS

All concrete pipe shall be joined with rubber gaskets. The joints and gasket Material shall meet the requirements of ASTM C 443. Gasket Material shall be handled and stored in accordance to Section 9-04.4(5).

9-05.7(4) TESTING CONCRETE SEWER PIPE JOINTS**9-05.7(4)A GENERAL**

When a particular type of pipe joint design, Material or joining method has not previously been tested and approved, the following test shall be made on one test length of the assembled concrete pipe, *or test length assembly as defined in Section 9-05.7(4)B*, to qualify the design, Material or method of joining the pipe. At the option of the Engineer, additional testing may be requested if subsequent field testing of installed pipe indicates difficulty in obtaining properly joined pipe. The tests shall be conducted at the manufacturer's yard, and the manufacturer shall make available space and facilities for conducting the tests in an efficient and workmanlike manner.

9-05.7(4)B HYDROSTATIC PRESSURE ON PIPES IN STRAIGHT ALIGNMENT

Hydrostatic pressure tests on pipes in straight alignment shall be made in accordance with the procedure outlined in paragraph 8(a) of AASHTO M 198, except that they shall be performed on a test length assembly consisting of not less than three nor more than five pipe sections selected from stock by the Engineer and assembled in accordance with standard installation instructions issued by the manufacturer. The end sections shall be bulkheaded and restrained against internal pressure.

9-05.7(4)C HYDROSTATIC PRESSURE TESTS ON PIPES IN MAXIMUM DEFLECTED POSITION

Upon completion of the test for pipe in straight alignment, the test section, or test length assembly, shall be deflected until at least two of the joints have been deflected to the maximum amount shown in the manufacturer's standard installation instructions. When thus deflected, there shall be no leakage at the joints from an applied internal hydrostatic pressure of 5 psi.

9-05.7(4)D HYDROSTATIC PRESSURE TEST ON 15 INCH DIAMETER AND LARGER PIPE UNDER DIFFERENTIAL LOAD

The test sections, or test length assembly, shall be suitably supported so that one of the pipes of the test assembly is suspended freely between adjacent pipes, bearing only on the joints. The suspended pipe shall then be loaded, at its midpoint, in addition to the weight of the pipe, in accordance with the following schedule:

Pipe Diameter	Load
15 inches	7,400 lbs.
18 inches	8,800 lbs.
21 inches	10,000 lbs.
24 inches and over	11,000 lbs.

While under this load, the stressed joints shall show no leakage when subjected to an internal hydrostatic pressure of 5 psi. At the option of the manufacturer, 1/2 of the load may be applied on the bell end of the suspended pipe in lieu of the full load on the center of the suspended pipe.

9-05.8 VITRIFIED CLAY PIPE

This Material shall not be used in the City of Seattle unless specified in the Contract. *Vitrified clay pipe shall conform to ASTM C 700, and all joints shall be factory manufactured in accordance with ASTM C 425.*

9-05.9 STEEL SPIRAL RIB DRAIN PIPE**9-05.9(1) GENERAL**

See Section 7-16.2 for restrictions on the use of corrugated metal pipe flow control systems and detention systems in landslide-prone areas, and for pipe to be maintained by the City in landslide-prone areas.

Steel spiral rib drain pipe shall meet the requirements of AASHTO M 36 and these Specifications. The size, coating, metal and protective treatment shall be as specified in the Contract.

The manufacturer of spiral rib drain pipe shall furnish to the Engineer a Manufacturer's Certificate of Compliance stating that the Materials furnished comply in all respects with these Specifications. The Engineer may require additional information or tests to be performed by the Contractor, at no expense to the Owner.

Unless otherwise specified in the Contract, spiral rib drain pipe shall be furnished with pipe ends cut perpendicular to the longitudinal axis of the pipe. Pipe ends shall be cut evenly. Spiral rib pipe shall be fabricated either by using a continuous helical lock seam with a seam gasket or a continuous helical welded seam paralleling the rib.

Spiral rib drain pipe shall have helical ribs that project outwardly, shall be formed from a single thickness of Material, and shall conform to one of the following configurations:

1. AASHTO M 36, Section 7.2.2.
2. 0.375 inch, $\pm 1/8$ inch wide by 0.4375 inch (minimum) deep at 4.80 inches center to center.
3. 3/4 inch wide by 5/8 inch deep at 12 inches center to center.

Pipe shall be fabricated with ends that can be effectively jointed with coupling bands.

When required, spiral rib pipe shall be bituminous treated or paved. The bituminous treatment for spiral rib pipe shall conform to the requirements of Sections 7-02.3(1)C3a and 9-05.4(4).

9-05.9(2) CONTINUOUS LOCK SEAM PIPE

9-05.9(2)A GENERAL

See Section 7-16.2 for restrictions on the use of corrugated metal pipe flow control systems and detention systems in landslide-prone areas, and for pipe to be maintained by the City in landslide-prone areas.

Pipes fabricated with a continuous helical seam parallel to the rib may be used for full circle pipe. The lock seam shall be formed in the flat between ribs and shall conform to Sections 7.5.1 through 7.5.3 of AASHTO M 36.

For narrow pitch spiral rib pipe, the lap width specified in AASHTO M 36, Section 7.5.1 shall be 1/4 inch.

For use in applications without bituminous treatment, the continuous lockseam shall require acceptance by qualification testing conducted by the Materials Laboratory.

9-05.9(2)B BASIS FOR ACCEPTANCE

The basis for acceptance will be a qualification test, conducted by the Materials Laboratory, for each manufacturer of helically corrugated, gasketed spiral rib, or narrow pitch spiral rib lock seam steel pipe. Only those specific pipe sizes and gasket Materials approved under the qualification test will be accepted.

Continuous lock seam pipe shall be sampled and tested in accordance with AASHTO T 249 and a Manufacturer's Certificate of Compliance shall be submitted indicating compliance of the pipe with these Specifications.

9-05.9(3) CONTINUOUS WELDED SEAM PIPE

See Section 7-16.2 for restrictions on the use of corrugated metal pipe flow control systems and detention systems in landslide-prone areas, and for pipe to be maintained by the City in landslide-prone areas.

Pipes fabricated with a continuous helical welded seam parallel to the ribs may be used for full circle pipe. The welding process for galvanized steel pipe shall be so controlled that the combined width of the weld and adjacent spelter coating burned by the welding does not exceed three times the thickness of the metal. If spelter is burned outside these limits, the weld and burned spelter shall be repaired as required for damaged galvanizing. Testing for welded seam quality control shall conform to AASHTO T 241. Welded pipe fabricated from aluminumized steel pipe shall have the coating of the welded area repaired by flame-sprayed metallizing inside and out after welding.

Repair of Damaged Galvanizing: When the galvanized (zinc coated) surface has been burned by gas or arc welding, all surfaces of the welded connections shall be thoroughly cleaned by wire brushing and all traces of the welding flux and loose or cracked galvanizing removed, after which the areas shall be repaired by flame spray metallizing both inside and out.

9-05.9(4) COUPLING BANDS

Coupling bands shall be of the same Material as the pipe. Coupling bands and gaskets shall conform to Section 9-05.10(2).

9-05.10 STEEL PIPE FOR SEWERS

9-05.10(1) GENERAL

See Section 7-16.2 for restrictions on the use of corrugated metal pipe flow control systems and detention systems in landslide-prone areas, and for pipe to be maintained by the City in landslide-prone areas.

Steel pipe shall conform to the requirements of Section 9-05.4 for steel Culvert pipe, except that protective coating shall be Treatment 5 as specified in Section 7-02.3(1)C3a, and shall be constructed of either helically corrugated lock seam or

helically corrugated continuous welded steel pipe. When gasketed helically corrugated lock seam steel pipe is called for, Treatment 5 is not required. Welded seam aluminum coated (aluminized) steel pipe shall require metallized aluminum coating inside and out following welding and shall not require Treatment 5.

9-05.10(2) COUPLING BANDS

Coupling bands for steel pipe shall conform to the details shown in WSDOT Standard Plan nos. B-13a through B-14 and to these Specifications:

Bands shall be made of the same base metal as the pipe and may be two nominal thicknesses lighter than used for the pipe but not thicker than 0.109 inch or lighter than 0.064 inch. Corrugations on the bands shall be the same size and shape as those on the pipe to be connected. Steel bolts and nuts shall meet the requirements of ASTM A 307, and galvanized in accordance with AASHTO M 232. Welds shall develop the full strength of the parent metal.

Type F bands may be used as an alternate to all other *band* types shown for steel pipe sizes 12 inch to 84 inch diameter inclusive, provided that two annular corrugations are formed on each pipe end to be joined. The end corrugation shall be 2 inches x 1/2 inch and the inside adjacent corrugation shall be 2-2/3 inches x 1/2 inch.

When annular corrugated bands are used to connect lock-seam helically corrugated pipes, the seam shall be welded at the pipe ends prior to recorrugating to prevent unraveling of the seam.

Coupling bands shall be made by the same manufacturer as the steel pipe selected for installation.

9-05.10(3) BASIS FOR ACCEPTANCE

The basis for acceptance of steel pipe will be the same as specified in Section 9-05.0, except when gasketed helically corrugated lock seam steel pipe is called for. A qualification test conducted by the Materials Laboratory will be required for each manufacturer of gasketed helically corrugated lock seam steel pipe. Only those specific pipe sizes and gasket Materials approved under the qualification test will be accepted.

9-05.11 ALUMINUM PIPE

9-05.11(1) GENERAL

See Section 7-16.2 for restrictions on the use of corrugated metal pipe flow control systems and detention systems in landslide-prone areas, and for pipe to be maintained by the City in landslide-prone areas.

Aluminum pipe shall conform to the requirements of Section 9-05.5 for aluminum Culvert pipe, except that the protective coating shall be Treatment 5 as specified in Section 7-02.3(1)C3a, and the pipe shall be constructed of helically corrugated lock seam aluminum pipe.

When gasketed helically corrugated lock seam aluminum pipe is called for, Treatment 5 is not required.

9-05.11(2) COUPLING BANDS

Section 9-05.10(2) shall apply to aluminum pipes, except the band shall not be more than 0.105 inches or less than 0.060 inches in thickness.

Coupling bands shall be made by the same manufacturer as the aluminum pipe selected for installation.

9-05.11(3) BASIS FOR ACCEPTANCE

The basis for acceptance of aluminum pipe will be the same as specified in Section 9-05.0, except when gasketed helically corrugated lock seam aluminum pipe is called for. A qualification test, conducted by the Materials Laboratory, will be required for each manufacturer of gasketed helically corrugated lock seam aluminum pipe. Only those specific pipe sizes and gasket Materials approved under the qualification test will be accepted.

9-05.12 PVC PIPE

Polyvinyl chloride pipe shall conform to the requirements of ASTM D 3034, SDR 35.

Joints for PVC pipe shall conform to ASTM D 3212 using restrained gasket conforming to ASTM F 477.

Fittings for PVC pipe shall be injection molded tees or factory solvent cemented saddle tees. Normally, all fittings shall be the same Material as the pipe being connected except that fittings using other Materials or constructed with more than one Material may be used subject to the approval of the Engineer. Fittings shall have sufficient strength to withstand handling and load stresses normally encountered.

9-05.13 DUCTILE IRON PIPE

Ductile iron pipe shall conform to ANSI A21.51 or AWWA C151 and shall be cement mortar lined, push-on joint, or mechanical joint. The ductile iron pipe shall be Class 50 unless indicated otherwise in the Contract.

Joints for ductile iron pipe shall be rubber gasketed conforming to the requirements of ANSI A21.11 or AWWA C111.

Cast iron fittings may be used with ductile iron pipe. Saddles fastened to pipe with external bands will not be acceptable on any new system. Normally, all fittings shall be the same Material as the pipe being connected, except that fittings using other Materials or constructed with more than one Material may be used subject to the approval of the Engineer.

at least 3 Working Days in advance. Fittings shall have sufficient strength to withstand handling and load stresses normally encountered.

9-05.14 PLASTIC FOAM (ETHAFOAM)

Polyethylene plastic foam used in sanitary Sewer and Storm Drain construction shall meet the Federal Specification PPP-C-1752C Type 1, Class 2, (Ethafoam).

9-05.15 ABS COMPOSITE PIPE

ABS (acrylonitrile butadiene styrene) material shall not be used unless specified in the Contract or permitted by the Engineer.

ABS composite pipe shall meet the requirements of AASHTO M 264.

ABS composite pipe shall be provided with Type OR (flexible gasketed) joints. Rubber gasketed joints shall conform to applicable provisions of ASTM C 443.

Fittings for ABS composite pipe shall be specifically designed for connection to ABS composite pipe with solvent cement. Normally, all fittings shall be the same material as the pipe being connected, except that fittings using other materials or constructed with more than one material may be used subject to the approval of the Engineer. Fittings shall have sufficient strength to withstand handling and load stresses encountered.

9-05.16 RESERVE

9-05.17 ALUMINUM SPIRAL RIB PIPE

9-05.17(1) GENERAL

See Section 7-16.2 for restrictions on the use of corrugated metal pipe flow control systems and detention systems in landslide-prone areas, and for pipe to be maintained by the City in landslide-prone areas.

Aluminum spiral rib pipe shall meet the requirements of AASHTO M 196 and these Specifications. The size, alloy, and protective treatment shall be as indicated in the Contract.

The manufacturer of spiral rib pipe shall furnish to the Engineer the Manufacturer's Certificate of Compliance stating that the Materials furnished comply in all respects with these Specifications. The Engineer may require additional information or tests to be performed by the Contractor, at no expense to the Owner.

Unless indicated otherwise in the Contract, spiral rib pipe shall be furnished with pipe ends cut perpendicular to the longitudinal axis of the pipe. Pipe ends shall be cut evenly. Spiral rib pipe shall be fabricated by using a continuous helical lock seam with a seam gasket.

For spiral rib pipe, helical ribs shall project outwardly from the smooth pipe wall and shall be fabricated from a single uniform thickness Material. The ribs shall be 3/4 inch wide by 3/4 inch deep with a nominal spacing of 7-1/2 inches center to center. Pipe shall be fabricated with ends that can be effectively jointed with coupling bands.

For narrow pitch spiral rib pipe, helical ribs shall project outwardly from the smooth pipe wall and shall be fabricated from a single thickness of Material. The ribs shall be 3/8 inch \pm 1/8 inch wide (measured outside to outside) and a minimum of 0.4375 inch high (measured as the minimum vertical distance from the outside of pipe wall to top surface of the rib). The maximum spacing of ribs shall be 4.80 inches center to center (measured normal to the direction of the ribs). *The radius of bend of the metal at the corners of the ribs shall be 0.0625 inch with an allowable tolerance of plus or minus 10 percent.*

For wide pitch spiral rib pipe, helical ribs shall project outwardly from the smooth pipe wall and shall be fabricated from a single thickness of Material. The ribs shall be 3/4 inch \pm 1/8 inch wide (measured outside to outside) and a minimum of 0.95 inch high (measured as the minimum vertical distance from the outside of pipe wall to top surface of the rib). The maximum spacing of ribs shall be 11.75 inches center to center (measured normal to the direction of the ribs). The radius of bend of the metal at the corners of the ribs shall be 0.0625 inch with an allowable tolerance of + 10 percent.

9-05.17(2) CONTINUOUS LOCK SEAM PIPE

Pipes fabricated with continuous helical lock seam parallel to the rib may be used for full circle pipe. The lock seam shall be formed in the flat between ribs and shall conform to Section 13.2.1 through 13.2.5 of AASHTO M 196.

9-05.17(3) BASIS FOR ACCEPTANCE

The basis for acceptance will be a qualification test, conducted by the Materials Laboratory, for each manufacturer of helically corrugated spiral rib, narrow pitch spiral rib or wide pitch spiral rib lock seam pipe. Only those specific pipe sizes and gasket Materials for manufacturers approved under the qualification test will be accepted.

Continuous lock seam pipe shall be sampled and tested in accordance with AASHTO T 249.

9-05.17(4) COUPLING BANDS

Coupling bands shall be of the same Material as the pipe. Coupling bands and gaskets shall conform to Section 9-05.10(2).

9-05.18 SAFETY BARS FOR CULVERT PIPE

Steel pipe used as safety bars and steel pipe used as sockets shall conform to the requirements of ASTM A 53, Grade B. Steel tubing used as safety bars shall conform to ASTM A 500, Grade B. Steel plate shall conform to ASTM A 36. All parts shall be galvanized after fabrication in accordance with AASHTO M 111.

9-05.19 FLOW CONTROL STRUCTURE

See Section 7-16.2 for restrictions on the use of corrugated metal pipe flow control systems and detention systems in landslide-prone areas, and for pipe to be maintained by the City in landslide-prone areas.

The flow control Structure shall be made from a standard manhole section as shown on Standard Plan no. 270 with diameter as indicated on the Drawings.

Where surface water is to enter directly through the cover of the flow control Structure, the frame and grate shall be as shown on Standard Plan no. 264, and the precast slab shall be as shown on Standard Plan nos. 243a and 243b with opening details to fit the diameter of the chamber. In all other cases, standard ring and cover (see Standard Plan no. 230) shall be used with a precast slab conforming to Standard Plans Series 200 with a 24 inch round opening. Manhole sections, castings and slabs shall meet the requirements of Section 7-05.

The control device and connection shall consist of PVC pipe cross with an orifice, a pipe connection, and shear gate with a galvanized steel chain. The diameters of the control device and connection shall be the same as the diameter of the outlet pipe as indicated on the Drawings. The PVC pipe used for the cross and connection shall meet the specifications of ASTM D 1785, Schedule 40. The PVC Material used for the orifice plate and the shear gate shall be plate Material meeting the Specifications of ASTM D 1784, PVC Class 12454-B. The orifice plate Material shall be 1/4 inch thick; the shear gate Material shall be 1/2 inch thick. The shear gate pin shall be of the same PVC Material as the shear gate. The sheargate chain shall be 12 gauge galvanized steel straight link chain attached to the Structure.

9-05.20 ALUMINUM PIPE FOR DETENTION

See Section 7-16.2 for restrictions on the use of corrugated metal pipe flow control systems and detention systems in landslide-prone areas, and for pipe to be maintained by the City in landslide-prone areas.

Aluminum detention pipe shall be helical or annular corrugated aluminum pipe, meeting the requirements of AASHTO M 196, Type I with the gauge as indicated on the Drawings. The end plate and all end plate reinforcement shall be aluminum alloy 6061-T6 structural plate with the thickness as indicated on the Drawings. The aluminum surfaces that are to be in contact with the Portland cement product (Controlled Density Fill (CDF), concrete, grout, mortar) shall first be cleaned with solvent and then painted with two coats of paint. This paint shall be aluminum surface treatment, and shall extend a minimum two feet beyond the area of contact with the Portland Cement product. The paint shall conform to Federal Specification TT-P-645 (Primer, Paint, Zinc Chromate, Alkyd Vehicle). Coupling bands for corrugated aluminum detention pipes shall be Type "D" per WSDOT Standard Plan no. B-13a.

9-05.21 STEEL PIPE FOR DETENTION

See Section 7-16.2 for restrictions on the use of corrugated metal pipe flow control systems and detention systems in landslide-prone areas, and for pipe to be maintained by the City in landslide-prone areas.

Steel detention pipe shall be galvanized helical or annular corrugated steel pipe, meeting the requirements of AASHTO M 36, Type 1, asphalt coated to requirements of AASHTO M 190, Type A with the gauge as indicated on the Drawings. The end plate and all end plate reinforcement shall be structural steel plate of the type and thickness as designated on the Drawings. Coupling bands for steel detention pipes shall be Type "D" per WSDOT Standard Plan no. B-13a.

9-05.22 GEOTEXTILES**9-05.22(1) GEOTEXTILE AND THREAD FOR SEWING**

The material shall be a geotextile consisting only of long chain polymeric fibers or yarns formed into a stable network such that the fibers or yarns retain their position relative to each other during handling, placement, and design service life. At least 95 percent by weight of the material shall be polyolefins or polyesters. The material shall be free from defects or tears. The geotextile shall also be free of any treatment or coating which might adversely alter its hydraulic or physical properties after installation. The geotextile shall conform to the properties as indicated in Tables 1 through 6 for each use specified in the Contract. Specifically, the geotextile uses included in this Section and their associated tables of properties are as follows:

Geotextile Application	Applicable Property Tables
Underground Drainage, Low Survivability, Classes A, B, and C	Tables 1 and 2
Underground Drainage, Moderate Survivability, Classes A, B, and C	Tables 1 and 2
Separation	Table 3
Soil Stabilization	Table 3
Permanent Erosion Control, Moderate Survivability, Classes A, B, and C	Tables 4 and 5
Permanent Erosion Control, High Survivability, Classes A, B, and C	Tables 4 and 5
Ditch Lining	Table 4
Temporary Silt Fence	Table 6

Thread used for sewing shall consist of high strength polypropylene, polyester, or polyamide. Nylon threads will not be allowed. The thread used to sew permanent erosion control geotextiles shall be resistant to ultraviolet radiation. The thread shall be of contrasting color to that of the geotextile itself.

9-05.22(2) GEOTEXTILE PROPERTIES

TABLE 1

Geotextile for underground drainage strength properties for survivability.

		Geotextile Property Requirements ¹	
Geotextile Property	Test Method ²	Low Survivability Woven / Nonwoven	Moderate Survivability Woven / Nonwoven
Grab Tensile Strength, min. in machine and x-machine direction	ASTM D 4632	180 lbs. / 115 lbs. min.,	250 lbs. / 160 lbs. Min
Grab Failure Strain, in machine and x-machine direction	ASTM D 4632	<50% / /50%	<50% / /50%
Seam Breaking Strength	ASTM D 4632 ³	160 lbs. / 100 lbs. min.	220 lbs. / 140 lbs. Min.
Puncture Resistance	ASTM D 4833	67 lbs. / 40 lbs. min.	80 lbs. / 50 lbs. Min.
Tear Strength, min. in machine and x-machine direction	ASTM D 4533	67 lbs. / 40 lbs. min	80 lbs. / 50 lbs. Min.
Ultraviolet (UV) Radiation stability	ASTM D 4355	50% strength retained min., after 500 hrs. in weatherometer	50% strength retained min., after 500 hrs. in weatherometer

See Notes after Table 6, this Specification.

TABLE 2

Geotextile for underground drainage filtration properties.

		Geotextile Property Requirements ¹		
Geotextile Property	Test Method ²	Class A	Class B	Class C
AOS	ASTM D 4751	.43 mm max. (No. 40 sieve)	.25 mm max. (No.60 sieve)	.18 mm max. (No.80 sieve)
Water Permittivity	ASTM D 4491	.5 sec ⁻¹ min.	.4 sec ⁻¹ min.	.3 sec ⁻¹ min.

See Notes after Table 6, this Specification.

TABLE 3

Geotextile for separation or soil stabilization.

		Geotextile Property Requirements ¹	
Geotextile Property	Test Method ²	Separation Woven/Nonwoven	Soil Stabilization Woven/Nonwoven
AOS	ASTM D 4751	.60 mm max. (No. 30 sieve)	.43 mm max. (No. 40 sieve)
Water Permittivity	ASTM D 4491	.02 sec ⁻¹ min.	.10 sec ⁻¹ min.
Grab Tensile Strength, min. in machine and x-machine direction	ASTM D 4632	250 lbs. / 160 lbs. min.	315 lbs./200 lbs. Min.
Grab Failure Strain, in machine and x-machine direction	ASTM D 4632	<50% / /50%	<50% / /50%
Seam Breaking Strength	ASTM D 4632 ²	220 lbs. / 140 lbs. min.	270 lbs./180 lbs. Min.
Puncture Resistance	ASTM D 4833	80 lbs. / 50 lbs. min.	112 lbs./79 lbs. Min.
Tear Strength, min. in machine and x-machine direction	ASTM D 4533	80 lbs. / 50 lbs. min.	112 lbs./79 lbs. Min.
Ultraviolet (UV) Radiation stability	ASTM D 4355	50% strength retained min., after 500 hrs. in weatherometer	50% strength retained min., after 500 hrs. in weatherometer

See Notes after Table 6, this Specification.

TABLE 4
Geotextile for permanent erosion and ditch lining.

		Geotextile Property Requirements¹		
		Permanent Erosion Control		Ditch Lining
Geotextile Property	Test Method²	Moderate Survivability Woven / Nonwoven	High Survivability Woven / Nonwoven	Woven / Nonwoven
AOS	ASTM D 4751	See Table 5	See Table 5	.60 mm max (No. 30 sieve)
Water Permittivity	ASTM D 4491	See Table 5	See Table 5	.02 sec ⁻¹ min.
Grab Tensile Strength, min. in machine and x-machine direction	ASTM D 4632	250 lbs. / 160 lbs. min	315 lbs. / 200lbs.min.	250 lbs. / 160 lbs. min.
Grab Failure Strain, in machine and x-machine direction	ASTM D 4632	15%- 50% / > 50%	15%- 50% / > 50%	<50% / ≥ 50%
Seam Breaking Strength	ASTM D 4632 ³	220 lbs./ 140 lbs. min.	270 lbs. / 180 lbs. min.	220 lbs. / 140 lbs. min.
Burst Strength	ASTM D 3786	400 psi/ 190 psi min.	500 psi / 320 psi min.	-----
Puncture Resistance	ASTM D 4833	80 lbs./ 50 lbs. min.	112 lbs. / 79 lbs. min.	80 lbs. / 50 lbs. min.
Tear Strength, min. in machine and x-machine direction	ASTM D4533	80 lbs./ 50 lbs. min.	112 lbs. / 79 lbs. min.	80 lbs. / 50 lbs. min.
Ultraviolet (UV) Radiation stability	ASTM D 4355	70% strength retained min., after 500 hrs. in weatherometer	70% strength retained min., after 500 hrs. in weatherometer	70% strength retained min., after 500 hrs. in weatherometer

See Notes after Table 6, this Specification.

TABLE 5
Filtration properties for geotextile for permanent erosion control.

		Geotextile Property Requirements¹		
Geotextile Property	Test Method²	Class A	Class B	Class C
AOS	ASTM D4751	0.43 mm max. (No.40 sieve)	0.25 mm max. (No.60 sieve).	0.22 mm max. (No. 70 sieve)
Water Permittivity	ASTM D4491	0.7 sec ⁻¹ min.	0.4 sec ⁻¹ min.	0.2 sec ⁻¹ min.

See Notes after Table 6, this Specification.

TABLE 6
Geotextile for temporary silt fence.

		Geotextile Property Requirements¹	
Geotextile Property	Test Method²	Unsupported Between Posts	Supported Between Posts with Wire or Polymeric Mesh
AOS	ASTM D 4751	.60 mm max. for slit film wovens (No. 30 sieve) .30 mm max. for all other geotextile types (No. 50 sieve) .15 mm min.(No. 100 sieve)	.60 mm max. for slit film wovens (No. 30 sieve) .30 mm max. for all other geotextile types (No. 50 sieve) .15 mm min. (No. 100 sieve)
Water Permittivity	ASTM D 4491	.02 sec ⁻¹ min.	.02 sec ⁻¹ min.
Grab Tensile Strength, min. in machine and x-machine direction	ASTM D 4632	180 lbs. min. in machine direction, 100 lbs. min. in x-machine direction	100 lbs. Min
Grab Failure Strain, min. in machine direction only	ASTM D 4632	30% max. at 180 lbs. or more	-----
Ultraviolet (UV) Radiation Stability	ASTM D 4355	70% Strength retained min., after 500 hrs. in weatherometer	70% Strength retained min., after 500 hrs. in weatherometer

Notes ¹ All geotextile properties in Tables 1 through 6 are minimum average roll values (i.e., the test result for any sampled roll in a lot shall meet or exceed the values shown in the table).

²The test procedures used are essentially in conformance with the most recently approved ASTM geotextile test procedures, except for geotextile sampling and specimen conditioning, which are in accordance with WSDOT Test Methods 914 and 915, respectively.

³With seam located in the center of 8-inch long specimen oriented parallel to grip faces.

9-05.22(3) AGGREGATE CUSHION FOR PERMANENT EROSION CONTROL GEOTEXTILE

Aggregate cushion for permanent erosion control geotextile, Class A shall meet the requirements of Section 9-03.9(2). Aggregate cushion for permanent erosion control geotextile, Class B or Class C, shall meet the requirements of Section 9-03.9(3) and 9-03.9(2).

9-05.22(4) GEOTEXTILE APPROVAL AND ACCEPTANCE

9-05.22(4)A SOURCE APPROVAL

The Contractor shall submit to the Engineer the following information regarding each geotextile proposed for use:

- manufacturer's name and current address,
- full product name, geotextile structure, including fiber/yarn type, and
- proposed geotextile use(s).

If the geotextile source has not been previously evaluated, a sample of each proposed geotextile shall be submitted to the SPU Materials Laboratory for evaluation. After the sample and required information for each geotextile type have arrived at the SPU Materials Laboratory, a maximum of 14 calendar Days will be required for this testing. Source approval will be based on conformance to the applicable values from Tables 1 through 6 in Section 9-05.22.

Source approval shall not be the basis of acceptance of specific lots of material unless the lot sampled can be clearly identified and the number of samples tested and approved meet the requirements of WSDOT Test Method 914.

9-05.22(4)B GEOTEXTILE SAMPLES FOR SOURCE APPROVAL

Each sample shall have minimum dimensions of 5 feet by the full roll width of the geotextile. A minimum of 6 square yards of geotextile shall be submitted to the Engineer for testing. The geotextile machine direction shall be marked clearly on each sample submitted for testing. The machine direction is defined as the direction perpendicular to the axis of the geotextile roll. Source approval for temporary silt fences will be by Manufacturer's Certificate of Compliance per Section 1-06.3.

The geotextile samples shall be cut from the geotextile roll with scissors, sharp knife, or other suitable method which produces a smooth geotextile edge and does not cause geotextile ripping or tearing. The samples shall not be taken from the outer wrap of the geotextile roll nor the inner wrap of the core.

9-05.22(4)C ACCEPTANCE SAMPLES

Samples will be randomly taken by the Engineer at the job site to confirm that the geotextile meets the property values specified.

Approval will be based on testing of samples from each lot. A "lot" shall be defined for the purposes of this Specification as all geotextile rolls within the consignment (i.e., all rolls sent to the Project Site) which were produced by the same manufacturer during a continuous period of production at the same manufacturing plant and have the same product name. After the samples have arrived at the SPU Materials Laboratory, a maximum of 14 calendar Days will be required for this testing. If the results of the testing show that a geotextile lot, as defined, does not meet the properties required for the specified use as indicated in Tables 1 through 6 in Section 9-05.22, the roll or rolls which were sampled will be rejected. Two additional rolls for each roll tested which failed from the lot previously tested will then be selected at random by the Engineer for sampling and retesting. If the retesting shows that any of the additional rolls tested do not meet the required properties, the entire lot will be rejected. If the test results from all the rolls retested meet the required properties, the entire lot minus the roll(s) which failed will be accepted. *All geotextile which has defects, deterioration, or damage will be rejected. All rejected geotextile shall be replaced at no expense to the Owner.*

9-05.22(4)D ACCEPTANCE BY CERTIFICATE OF COMPLIANCE

When the quantities of geotextile proposed for use in each geotextile application are less than or equal to the following amounts, acceptance shall be by Manufacturer's Certificate of Compliance:

Application	Geotextile Quantity
Underground Drainage	600 sq. yards
Soil Stabilization and Separation	1,800 sq. yards
Permanent Erosion Control	1,200 sq. yards
Temporary Silt Fence	All quantities

The Manufacturer's Certificate of Compliance shall include the following information about each geotextile roll to be used:

- Manufacturer's name and current address,
- Full product name,

- Geotextile structure, including fiber/yarn type,
- Geotextile roll number,
- Proposed geotextile use(s), and
- Certified test results.

9-05.22(4)E APPROVAL OF SEAMS

If the geotextile seams are to be sewn in the field, the Contractor shall provide a section of sewn seam which can be sampled by the Engineer before the geotextile is installed.

The seam sewn for sampling shall be sewn using the same Equipment and procedures as are to be used to sew the production seams. If production seams are to be sewn in both the machine and cross-machine directions, the Contractor shall provide sewn seams for sampling which are oriented in both the machine and cross-machine directions. The seams sewn for sampling shall be at least 2 yards in length in each geotextile direction. If the seams are sewn in the factory, the Engineer will obtain samples of the factory seam at random from any of the rolls to be used. The seam assembly description shall be submitted by the Contractor to the Engineer and are to be included with the seam sample obtained for testing. This description shall include the seam type, stitch type, sewing thread type(s), and stitch density.

9-05.23 CEMENT SLURRY - ABANDONING PIPE AND FILLING ANNULAR SPACE BETWEEN 2 PIPES

Cement slurry used to fill the annular space between an inner and outer pipe shall be pumpable, flowable, and shall completely fill the annular space. Materials shall have the following properties:

Material Reference	Material Property
Cement, ASTM C 150	Type I / II
Slurry Density, ASTM C 138	65 pcf (minimum)
Foamed Slurry Density, ASTM C 138	45 pcf (minimum)
Water / Cement Ratio	0.90 (maximum)
Flow, ASTM C 939	18 seconds (maximum)
Shrinkage, ASTM C 827	non-shrink
Bleeding, ASTM C 232	no bleed
Set Time, ASTM C 403	3 - 6 hours ¹
Compressive strength	
ASTM C 403 @ 24 hours	75 psi (minimum)
ASTM C 495 @ 7 Days	150 psi (minimum)
ASTM C 495 @ 28 Days	250 psi (minimum)

¹Set time depends on temperature and site conditions.

SECTION 9-06 STRUCTURAL STEEL AND RELATED MATERIALS**9-06.1 STRUCTURAL CARBON STEEL**

Structural carbon steel shall conform to the requirements of AASHTO M 270, Grade 36, Structural Steel For Bridges, unless the Contract specifies AASHTO M 183, Structural Steel.

9-06.2 STRUCTURAL LOW ALLOY STEEL

Structural low alloy steel shall conform to the requirements of AASHTO M 270, Grades 50 or 50W as specified in the Contract, unless the Contract specifies AASHTO M 223 or AASHTO M 222.

9-06.3 STRUCTURAL HIGH STRENGTH STEEL

Structural high strength steel shall be high yield strength, quenched and tempered structural steel conforming to the requirements of AASHTO M 270, Grades 70W, 100, or 100W as called out in the Contract, unless the Contract specifies AASHTO M 244.

9-06.4 RESERVED**9-06.5 BOLTS****9-06.5(1) UNFINISHED BOLTS**

Unfinished bolts (ordinary machine bolts) shall conform to the specification requirements of ASTM A 307, Grade A or B. Nuts shall comply with ASTM A 563, Grade A requirements. Washers, unless otherwise specified in the Contract, shall meet ASTM F 844 specifications.

The Contractor shall submit a Manufacturer's Certificate of Compliance for the bolts, nuts, and washers prior to installing any of them.

9-06.5(2) RESERVED**9-06.5(3) HIGH STRENGTH BOLTS**

High strength bolts for structural steel joints shall conform to the requirements of AASHTO M 164 or AASHTO M 253, Type 1, Type 2, or Type 3.

Bolts conforming to AASHTO M 164 that are galvanized in accordance with AASHTO M 232 shall be tested for embrittlement after galvanization. Test for embrittlement shall be in accordance with ASTM F 606, Section 7. Bolts conforming to AASHTO M 253 shall not be galvanized. AASHTO M 253 Type 1 and Type 2 bolts shall be painted with two coats of zinc rich paint, formula A-9-73, consisting of a minimum dry film thickness of 2 mils per coat.

Unpainted and nongalvanized bolts shall conform to AASHTO M 164 and AASHTO M 253, Type 3.

Nuts for high strength bolts shall meet the following requirements:

Bolt Type	Requirement
AASHTO M 164 Bolts	
Black Type 1	AASHTO M 291 Grade C, C3, HD, DH3
AASHTO M 292 Grade 2H	
Black weathering Type 3	AASHTO M 291 Grade C3 and DH3
Galvanized Type 1	AASHTO M 291 Grade DH AASHTO M 292 Grade 2H
AASHTO M 253 Bolts	
Black Type 1 and 2	AASHTO M 291 Grade DH, DH3 AASHTO M 292 Grade 2H
Black weathering Type 3	AASHTO M 291 Grade DH3

Nuts that are to be galvanized shall be tapped oversized the minimum required for proper assembly. The amount of overlap shall be such that the nut assembles freely on the bolt in the coated condition and shall meet the mechanical requirements of AASHTO M 291 and the rotational capacity test specified in AASHTO M 164. The overlapping requirements of AASHTO M 291 Section 7.4 shall be considered maximum values.

Galvanized nuts shall be lubricated in accordance with AASHTO M 291 including supplementary requirement S2. Documentation shall include the name, method of application, and dilution of the lubricant applied to the nuts.

Washers for AASHTO M 164, Type 1 and Type 3 bolts, and AASHTO M 253, Type 1, Type 2, and Type 3 bolts shall meet the requirements of AASHTO M 293. The surface condition and weathering characteristics of the washers shall be the same as for the bolts being specified.

Direct Tension Indicators shall conform to the requirements of ASTM F 959 and may be used with either AASHTO M 164 or AASHTO M 253 bolts. Direct tension indicators shall be galvanized by mechanical deposition in accordance with AASHTO M 298, Class 55. Hot dip galvanizing will not be allowed.

All bolts, nuts, and direct tension indicators shall be marked and identified as required in the pertinent Specifications.

Lock-pin and collar fasteners which meet the materials, manufacturing, and chemical composition requirements of AASHTO M 164 or AASHTO M 253, and which meet the mechanical property requirements of the same specification in full size tests, and which have a body diameter and bearing areas under lock-pin head and collar not less than those provided by a bolt and nut of the same nominal size may be used. The Contractor shall submit a detailed installation procedure to the Engineer for approval. Should approval to use a lock-pin and collar fastener be given by the Engineer, it will be given prior to use on these types of fasteners.

The Contractor shall provide Manufacturer's Certificate of Compliance for all bolts, nuts, washers, and load indicators. The Manufacturer's Certificate of Compliance shall include certified mill test reports and test reports performed on the finished bolt confirming that all of the Materials provided meet the requirements of the applicable AASHTO or ASTM specification. The documentation shall also include the name and address of the ASTM or AASHTO accredited test Laboratory, the date of testing, the lot identification of the bolts and nuts, and coating thickness for galvanized bolts and nuts. Shipping containers (not lids) shall be marked with the lot identification of the item contained therein.

Bolts shall be sampled prior to incorporating into a Structure. For the purposes of selecting samples, a lot of bolts shall be the quantity of bolts of the same nominal diameter and same nominal length in a consignment shipped to the Project Site. The minimum number of samples from each lot shall be as follows:

Lot Size	Sample Size ^{1,2}
0 to 50	*-----
51 to 150	4
151 to 1,200	6
1,201 to 10,000	10
10,001 to 35,000	16
35,001 and over	24

Notes

* *Manufacturer's Certificate of Compliance* required — samples not required.

¹ Bolts are galvanized, increase the sample size by 1.5 times the table value for the number of bolts being sampled.

² Nuts, washers, and load indicator devices shall be sampled at the same frequency as the bolts.

All testing of bolts, nuts, washers, and load indicating devices shall be performed on specimens as they are to be installed.

All samples shall include a Manufacturer's Certificate of Compliance for each lot of bolts provided as defined in Section 1-06.3.

9-06.5(4) ANCHOR BOLTS

Anchor bolts shall meet the requirements of ASTM A 449. Galvanized anchor bolts shall be tested for embrittlement after galvanization in accordance with ASTM A 143. For galvanized anchor bolts with a length less than five times the nominal bolt diameter, the bolts shall be tested for embrittlement in accordance with ASTM F 606, Section 7.

Nuts for ASTM A 449 black anchor bolts shall conform to AASHTO M 291, Grade C. Nuts for ASTM A 449 galvanized bolts shall conform to AASHTO M 291, Grade DH and shall conform to the lubrication requirements of Section 9-06.5(3). Nuts for AASHTO M 164 black anchor bolts shall conform to AASHTO M 291, Grade C, C3, DH, and DH3 or AASHTO M 292, Grade 2H. Nuts for AASHTO M 164 galvanized anchor bolts shall conform to AASHTO M 291, Grade DH or AASHTO M 292, Grade 2H. Washers for ASTM A 449 anchor bolts shall conform to AASHTO M 293. Washers for AASHTO M 164 anchor bolts shall conform to ASTM F 436.

The bolts shall be tested by the manufacturer in accordance with the requirements of the pertinent specification and as specified in these Specifications. Anchor bolts, nuts, and washers shall be inspected prior to shipping to the Project Site. The Contractor shall submit to the Engineer for approval a Manufacturer's Certificate of Compliance for the anchor bolts, nuts, and washers, as defined in Section 1-06.3. If the Engineer deems it appropriate, the Contractor shall provide a sample of the anchor bolt, nut, and washer for testing.

All bolts, nuts, and washers shall be marked and identified as required in the pertinent specification.

9-06.6 RESERVED**9-06.7 RESERVED****9-06.8 STEEL CASTINGS**

Steel castings shall conform to the requirements of AASHTO M 103, Mild to Medium Strength Carbon-Steel Castings for General Application, grade 70-36, *unless otherwise designated in the Contract*.

9-06.9 GRAY IRON CASTINGS

Gray iron castings shall conform to the requirements of AASHTO M 105. *The class of castings to be furnished shall be as designated in the Contract.*

9-06.10 MALLEABLE IRON CASTINGS

Malleable iron castings shall conform to the requirements of ASTM A 47.

9-06.11 STEEL FORGINGS AND STEEL SHAFTING

Steel forgings shall conform to the requirements of AASHTO M 102. *The classes of forgings to be furnished shall be those specified in the Contract.*

Steel shafting shall conform to the requirements of AASHTO M 169, Grade Designation 1016 to 1030 inclusive, *unless otherwise specified in the Contract.*

9-06.12 BRONZE CASTINGS

Bronze castings shall conform to the requirements of AASHTO M 107, Bronze Castings for Bridges and Turntables.

9-06.13 COPPER SEALS

Copper sheets for seals shall conform to the requirements of AASHTO M 138. They shall be UNS C12500, light cold rolled, and furnished in flat sheets each not less than 0.018 inch in thickness.

All splices or joints shall be carefully brazed or soldered to produce a continuous watertight seal for the full length of each unit.

9-06.14 DUCTILE IRON CASTINGS

Ductile iron castings shall conform to the requirements of ASTM A 536, Grade 80-55-06, *unless otherwise specified in the Contract.*

9-06.15 WELDED SHEAR CONNECTORS

Welded shear studs shall be made from cold drawn bar stock conforming to the requirements of AASHTO M 169, Grades 1010 through 1020, inclusive, either semi-killed or killed deoxidation.

The Material shall conform to the following mechanical properties:

Tensile Strength	60,000 psi min.
Yield Strength	50,000 psi min.
Elongation	20% min.
Reduction of Area	50% min.

Mechanical properties shall be determined in accordance with AASHTO Methods and Definitions T 244.

At the manufacturer's option, mechanical properties of the studs shall be determined by testing either the steel after cold finishing, or the full diameter finished studs.

9-06.16 ROADSIDE SIGN STRUCTURES

All bolts shall conform to AASHTO M 164. Washers for bolts shall be per AASHTO M 293.

Posts for single post sign structures shall meet the requirements of ASTM A 500, Grade B or ASTM A 53, Grade B.

Posts for multiple post sign structures shall meet the requirements of AASHTO M 183. Posts meeting the requirements of AASHTO M 222 or AASHTO M 223, Grade 50 may be used as an acceptable alternate to the AASHTO M 183 posts. All steel not otherwise specified shall conform to AASHTO M 183.

Triangular base stiffeners for one-directional multi-post sign posts shall meet the requirements of AASHTO M 222 or AASHTO M 223, Grade 50.

Base connectors for multiple directional steel breakaway posts shall conform to the following:

Bracket	Aluminum Alloy 6061 T-6
Bosses for Type 2B Brackets	ASTM A 582
Coupling Bolts	AASHTO M 164
Anchor Bolts	Type 304 stainless steel for threaded portion, AISI 1038 steel rod and AISI 1008 coil for cage portion.

Anchor couplings for multiple directional steel breakaway posts shall have a tensile breaking strength range as follows:

Type 2A	17,000 to 21,000 lb.
Type 2B	47,000 to 57,000 lb.

For multi-directional breakaway base connectors, shims shall be fabricated from pregalvanized sheet steel. For one-directional breakaway base connectors, single post or multi-post, shims shall be fabricated from brass conforming to ASTM B 36.

9-06.17 RESERVED**9-06.18 METAL BRIDGE RAILING**

Metal bridge railing shall conform to the type and Material Specifications set forth in the Contract.

Section 8, part (b) of the Aluminum Association Standard Specifications for Aluminum Railing Posts Alloy A 344-T4 is hereby revised to provide that no X-ray inspection will be required after a foundry technique has been established for each mold which ensures production of castings that are free from harmful defects. Inspection for approval of castings will be made by the Engineer after the finished castings have been anodized as noted on the Drawings.

Welding of aluminum shall be in accordance with Section 6.9 of the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals, Fourth Edition-2001.

9-06.19 RESERVED

9-06.20 RESERVED**9-06.21 RESERVED****9-06.22 BOLTS, WASHERS, AND OTHER HARDWARE**

Ordinary machine bolts and flat head bolts shall be made from commercial bolt stock meeting the specifications of ASTM A 307, and shall be grade A. Drift bolts and dowels may be either wrought iron or medium steel. Washers may be cast iron or malleable iron or may be cut from medium steel or wrought iron plate.

All bolts and other hardware which are to be galvanized and which require bending or shaping shall be hot forged to the required shape before galvanizing. Cold bending of such Material will not be permitted because of the tendency toward embrittlement during the galvanizing process. Galvanizing shall be in accordance with AASHTO M 232.

Split rings for log cribbing of 4 inches inside diameter shall be manufactured from hot rolled, low-carbon steel conforming to ASTM A 711 AISI, Grade 1015. Each ring shall form a true circle with the principle axis of the cross-section of the ring metal parallel to the geometric axis of the ring. The thickness of the metal section shall be 0.195 inch plus or minus 0.010 inch and the section shall be beveled from the central portion toward the edges to a thickness of 0.145 inch plus or minus 0.010 inch. It shall be cut through in one place in its circumference to form a tongue and slot. Split ring connectors shall be galvanized in accordance with AASHTO M 232.

Spike-grid timber connectors shall be manufactured according to ASTM A 47 for malleable iron castings. They shall consist of 4 rows of opposing spikes forming a 4-1/8 inch square grid with 16 teeth which are held in place by fillets which are diamond shaped in cross-section.

Nails shall be round wire of standard form. Spikes shall be wire spikes or boat spikes, as specified on the Drawings. Bolts, dowels, washers, and other hardware, including nails, shall be black or galvanized as specified on the Drawings, but if not so specified shall be galvanized when used in treated timber Structures.

SECTION 9-07 REINFORCING STEEL**9-07.1 GENERAL**

Deformed steel bar shall be free from loose mill scale, dirt, grease, or other defects affecting the strength of bond with concrete. Deformed steel bar coated with rust shall be vigorously wire brushed clean. Size numbers shall be taken to represent the diameter of the bar in 1/8 inch units, except where standard wire gauge sizes are indicated in the Contract.

9-07.1(1) ACCEPTANCE BY MANUFACTURER'S CERTIFICATION

Reinforcing steel may be accepted by the Engineer based on the Manufacturer's Certificate of Compliance.

9-07.1(2) BENDING

Steel reinforcing bars shall be cut and bent by careful and competent workmen. They shall be bent cold to templates, which shall not vary appreciably from the shape and dimension shown on the Drawings.

Hooks and bends of steel reinforcing bars shall be bent to the following inside diameters unless shown otherwise on the Drawings:

Bar Size	Stirrups and Ties	All Other Bars
No. 3	1-1/2 "	6 bar diameters
No. 4	2"	6 bar diameters
No. 5	2-1/2 "	6 bar diameters
No. 6	4-1/2 "	6 bar diameters
No. 7	5-1/4"	6 bar diameters
No. 8	6"	6 bar diameters
No. 9 through No. 11	---	8 bar diameters
No. 14 through No. 18	---	10 bar diameters

The supplementary requirements of AASHTO M 31 for bend tests shall apply to size No. 14 and No. 18 steel reinforcing bars which have hooks or bends.

9-07.1(3) LENGTHS

Net lengths of bent bars shown in the "LENGTH" column of the bar list on the Drawings are rounded to the nearest inch. Net length is the length of bar after all bend deductions are subtracted from the gross length.

The following bend deductions per 90 degrees bend have been subtracted from the gross length:

Bar Size	Stirrups and Ties	All Other Bars
No. 3	3/4"	1"
No. 4	1"	1-1/4"
No. 5	1-1/4"	1-1/2"
No. 6	1-7/8"	1-7/8"
No. 7	2-1/4"	2-1/4"
No. 8	2-1/2"	2-1/2"
No. 9	---	3-3/8"
No. 10	---	3-3/4"
No. 11	---	4-1/8"
No. 14	---	5-3/4"
No. 18	---	7-5/8"

For bends other than 90 degrees, a direct proportion of these deductions will be used. *The following bend deductions will apply, except where bending radii are shown on the Drawings.*

For standard hooks on the ends of bars, the following hook lengths, in addition to the out to out detailed dimension, have been provided:

Bar Size	Length Added for One Hook				
	180° Hook	135° Hook		90° Hook	
	All Bars	Seismic Ties	All Other Bars	Stirrup and Ties	All Other Bars
No. 3	5-1/8"	4-7/8"	3-5/8"	2-7/8"	5-1/8"
No. 4	6"	6-1/2"	4-1/2"	3-1/2"	6-3/4"
No. 5	6-7/8"	8"	5-3/8"	4-3/8"	8-1/2"
No. 6	8-1/4"	10-3/4"	7-3/4"	10-1/8"	10-1/8"
No. 7	9-5/8"	1' 0-1/2"	9"	11-7/8"	11-7/8"
No. 8	11"	1' 2-1/4"	10-1/4"	1' 1-1/2"	1' 1-1/2"
No. 9	1' 2-7/8"	---	---	---	1' 3-7/8"
No. 10	1' 4-5/8"	---	---	---	1' 5-7/8"
No. 11	1' 6-1/2"	---	---	---	1' 7-7/8"
No. 14	2' 1-7/8"	---	---	---	2' 0-3/4"
No. 18	2' 10-1/2"	---	---	---	2' 9-1/8"

9-07.1(4) INSPECTION

Before rolling work begins, the Contractor shall provide enough advance notice that the Engineer may arrange to inspect it. The Contractor shall inform the Engineer of who shall do the work and where it shall be done. No Material shall be rolled until the Engineer gives Written Notice to proceed.

9-07.2 DEFORMED STEEL BARS

Deformed steel bars for concrete reinforcement shall conform to the requirements of AASHTO M 31, Deformed and Plain Billet Steel Bars for Concrete Reinforcement, Grade 60, or ASTM A 706, Low-Alloy Steel, Deformed Bars for Concrete Reinforcement. However, in computing the ultimate unit tensile stress from test data, the area may be corrected for mass per linear foot of the bar within the weight tolerances listed. No such correction for mass shall be used in calculating the yield stress; the nominal area of the bar, as given in Table 1 of AASHTO M 31 or ASTM A 706, shall be used in this computation.

Deformed steel bars are referred to in the Contract by number: for example, No. 3, No. 4, No. 5, etc.

9-07.3 EPOXY-COATED STEEL REINFORCING BARS

Epoxy-coated rebar shall be coated according to AASHTO M 284 with the additional following modifications:

- The list of steel reinforcing bars acceptable for coating shall include ASTM A 706.
- The Contractor shall furnish a *Manufacturer's Certificate of Compliance* that properly identifies the material, the number of each batch of coating material used, quantity represented, date of manufacture, name and address of manufacturer, and a statement that the supplied coating material meets the requirements of AASHTO M 284.
- The Contractor shall supply to the Engineer an 8 ounce representative sample of the coating material from each batch of coating material. *The sample shall be packaged in an airtight container and identified as epoxy coating material by batch number.*
- Prior to coating the bars, the Contractor shall submit to the Engineer for review, the coating material manufacturer's recommendation on the proper use and application requirements of the coating material.
- A *Manufacturer's Certificate of Compliance* stating that all bars have been coated in accordance with the coating material manufacturer's recommendations and these Specifications shall be furnished with each

- shipment. This certification shall include for each bar size the preheat temperatures, cure times, thickness checks, holidays detected, and test results. Two copies of these certifications shall be furnished to the Engineer.
6. *The Contractor shall give advance notice to the Engineer of the coating schedule at the coating plant so that Engineer inspection for approval may be provided.*
 7. The patching material, compatible with the coating material and inert in concrete, shall be supplied to the purchaser.
 8. For Projects where epoxy-coated steel reinforcing bars are used in the top mat of bridge decks only, the maximum amount of damage to the coating shall not exceed 0.25 percent of the surface area of each bar.
 9. The thickness of epoxy-coating shall be 10 mils \pm 2 mils.
 10. All samples shall be submitted to the SPU Materials Laboratory.

9-07.4 PLAIN STEEL BARS

Where plain steel bars are specified, they shall conform to the chemical and physical properties of AASHTO M 31, Grade 60, unless specifically noted otherwise. Plain steel bars are indicated in the Contract by fractions of an inch; for example, 3/8 inch \varnothing , 1/2 inch \varnothing , 5/8 inch \varnothing , etc.

9-07.5 DOWEL BARS (FOR CEMENT CONCRETE PAVEMENT)

Dowel bars shall be plain steel bars of the dimensions shown in the Standard Plans. They shall conform to AASHTO M 31, Grade 60 or AASHTO M 255, Grade 60, and shall be coated in accordance with AASHTO M 284. The ends of the bars shall be coated to a minimum of 4 mils. In addition, the requirements of Section 9-07.3, items 2, 3, 4, 5, 6, 7, and 10 shall apply.

9-07.6 TIE BARS (FOR CEMENT CONCRETE PAVEMENT)

Tie bars shall conform to the requirements of the Standard Specifications for Deformed Billet-Steel Bars for Concrete Reinforcement, AASHTO M 31, Grade 40 and shall be coated in accordance with AASHTO M 284. *Deformed bar shall be 5/8 inch diameter and 30 inch long.*

The form of the deformed bar shall be subject to approval by the Engineer.

Tie bars shall be free from dirt, grease, or other defects affecting the strength or bond with the concrete. Tie bars shall be epoxy encapsulated.

9-07.7 WIRE MESH

Wire mesh for concrete reinforcement shall conform to the requirements of AASHTO M 55, Welded Steel Wire Fabric for Concrete Reinforcement or AASHTO M 221, Welded Deformed Steel Wire Fabric for Concrete Reinforcement. All wire mesh shall be of an approved kind and quality of manufacture.

9-07.8 DEFORMED WIRE

Deformed wire shall conform to the requirements of AASHTO M 225, Deformed Steel Wire for Concrete Reinforcement.

Deformed wire is noted in the Contract by the letter D, followed by a number indicating the cross-sectional area of the wire; for example, D2, D5, D20, etc.

9-07.9 COLD DRAWN WIRE

Cold drawn wire shall conform to the requirements of AASHTO M 32, Cold Drawn Steel Wire for Concrete Reinforcement.

Cold drawn wire is noted in the Contract by the letter W followed by a number indicating the cross-sectional area of the wire; for example, W2, W5, W20, etc.

9-07.10 PRESTRESSING REINFORCEMENT

Prestressing reinforcement shall be 1/2 inch diameter for prestressed concrete girders or precast-prestressed concrete piles and 1/2 inch or 0.6 inch diameter for cast-in-place prestressed concrete.

Prestressing reinforcement shall be mill bright high-tensile-strength seven wire low-relaxation strand conforming to the requirements of AASHTO M 203, Grade 270.

Prestressing reinforcement shall not be coupled or spliced.

All prestressing reinforcement furnished for a given structural member shall have a maximum elongation differential of 3 percent at stress of 0.8 of the ultimate strength of the prestressing steel. Each reel of prestressing reinforcement shall be accompanied by a Manufacturer's Certificate of Compliance, a mill certificate, and a test report. The mill certificate and test report shall include the chemical composition, the yield and ultimate strengths, elongation at rupture, modulus of elasticity, and the stress strain curve for the actual prestress reinforcing intended for use. All values certified shall be based on test values and actual sectional areas of the material being certified.

For each reel furnished, a sample, not less than 5 feet long, shall be sent to the SPU Materials Laboratory for testing.

SECTION 9-08 PAINTS**9-08.1 RAW MATERIALS**

The acceptance of particular lots of raw materials shall in no way obligate the Engineer to accept lots of finished paint that do not conform to the requirements of these Specifications. When not specifically detailed, the raw Materials shall meet the requirements of the applicable Federal Specification in effect at the time of manufacture. Products not covered by State or Federal Specifications shall be of top quality, meeting prevailing commercial standards. Raw Materials for paints shall conform to the requirements of the Specifications *as follows*:

Alkyd resin solution, Federal TT-R-266, Type I or Type II.

Aluminum paste, ASTM D 962, Type 2, Class B. Paints made with the paste shall be smooth and highly lustrous.

Anti-skinning agent shall have no deleterious effect on the drying time of the finished paint. It shall effectively prevent skinning when added in the amounts specified in each formula and tested in accordance with Federal Test Std. No. 141a, Method 3021.

Aromatic petroleum thinner - water white low aniline petroleum solvent Kauri-Butanol value70 (min.).

Barium sulfate pigment, ASTM D 602.

Chrome oxide green, ASTM D 263. The tinting properties shall be such that the standard color of the formulas using chrome oxide green can be produced without departing from the limits of composition given in those formulas.

Chrome yellow pigment and paste, ASTM D 211, Type III.

Fibrous magnesium silicate (talc), ASTM D 605.

Lampblack pigment and paste, ASTM D 209.

Liquid drier, ASTM D 600.

Mineral spirits, ASTM D 235.

Raw linseed oil, ASTM D 234.

Red iron oxide pigment, ASTM D 3721, ASTM D 3722 & ASTM D 3724.

Silica shall be finely ground amorphous or crystalline material. It shall have a maximum oil absorption of 50 when tested in accordance with ASTM D 281.

Soya lecithin shall be pure.

Spar varnish, Federal TT-V-119.

Titanium pigments, ASTM D 476. Titanium dioxide for use in exterior white paints shall conform to Type II. Titanium pigments used in tinted paints and enamels shall be exterior chalk resistant, Type III.

Turpentine shall be gum spirits of turpentine, ASTM D 13.

Yellow iron oxide, hydrated, ASTM D 768.

Zinc oxide pigment and paste, ASTM D 79.

Zinc yellow (zinc chromate), ASTM D 478.

Raw materials not specifically covered shall meet current Federal Specifications for said material.

9-08.2 PAINT FORMULAS - GENERAL

All paints shall be made from materials meeting the requirements specified in Section 9-08.1. The paint shall be made in accordance with the following formulas and shall meet the requirements set forth above as well as the special requirements set forth for each formula. The formulas are stated in terms of dry pigment. Each formula shall contain the specified raw materials which shall be proportioned to give the compositions in percentages by weight or parts by weight, as shown in the formulas that follow.

1. Formula A-5-61 - Vinyl Pretreatment:

The primer shall meet the requirements of Federal Specification MIL-P-15328B or MIL-P-15328C, Primer Pretreatment (Formula 117B for Metals).

Vinyl Wash Primer shall be mixed by adding 1 volume of acid component (diluent) to 4 volumes of resin component (base solution) slowly and with constant stirring. The material shall be used within 8 hours of mixing. The wash primer coat shall be spray applied to all surfaces at a coverage rate of 250 to 300 square feet per gallon to yield a dry film of 0.5 to 0.9 mils thickness. If necessary to maintain a wet spray, additional thinning with normal Butanol or 99 percent Isopropanol will be allowed. Acid component above the required amount shall not be used for thinning. A drying time of 1 hour is required before recoating.

- a. Butanol shall meet Federal Specification TT-B-846b Butyl Alcohol; Normal.
- b. Isopropanol (99 percent) shall conform to ASTM D 770 Isopropyl Alcohol.

2. Formula A-6-86 - Zinc Dust Zinc Oxide Primer:

The primer shall meet the requirements of Federal Specification TT-P-641 Primer - Paint: Zinc Dust-Zinc Oxide Type

III.

3. **Formula A-9-73 - Galvanizing Repair Paint, High Zinc Dust Content:**

The galvanizing repair paint shall meet the requirements of Federal Specification MIL-P-21035 (Ships) Paint, High Zinc Dust Content, Galvanizing Repair.

4. **Formula C-6-90 - Green Phenolic Finish Coat for Steel:**

Zinc chromate (dry pigment)	13.8 parts
Chrome green oxide (dry pigment)	16.1 parts
Titanium dioxide (dry pigment)	16.7 parts
Yellow iron oxide (dry pigment)	1.3 parts
Fibrous magnesium silicate (dry pigment)	5.0 parts
Aluminum stearate (dry pigment)	0.2 parts
Spar varnish	22.1 parts
Raw linseed oil	21.4 parts
Driers	1.0 parts
Anti-skinning agent	0.1 parts
Mineral spirits	2.3 parts
Weight per gallon (minimum)	12.5 pound
Viscosity at 70°F	80 ± 8 K.U.
Grind (Minimum)	6
Set to touch	4 hours
Dry hard	18 hours
Sag Index	7 min.
Test Requirements	Prior to shipment
Viscosity Adjustment	Mineral spirits to be added at the factory to achieve the specified viscosity

The proportions of tinting pigments may be varied to achieve the desired color. The color of the paint when dry shall match the color of a standard C-6-90 color chip. Additional tinting pigments may be required.

5. **Formula C-9-90 - Phenolic Finish Coat for Steel:**

Zinc Oxide (dry pigment)	10.0 parts
Titanium Dioxide (dry pigment)	21.0 parts
Fibrous Magnesium Silicate (dry pigment)	3.2 parts
Barium Sulfate (dry pigment)	12.8 parts
Tinting Pigments	5.9 parts
Treated Bentonite Clay (dry pigment)	0.2 parts
Anti-Sag Agent	1.9 parts
Raw Linseed Oil	12.6 parts
Spar Varnish	29.0 parts
Anti-Skin Agent	0.1 parts
Driers	1.0 parts
Mineral Spirits	1.8 parts
Xylene	0.5 parts
Weight per gallon (minimum)	12.3 lbs.
Viscosity	80 ± 8 K.U.
Dry Hard (maximum)	18 hours
Set to Touch (maximum)	4 hours
Grind (N.S.) (minimum)	5
Sag Index (minimum)	4
Total Solids by Weight	80 ± 5%
Test Requirements	Prior to shipment

Adjustments for tinting pigments and talc, solvents and chemical additives shall be made at the factory to achieve the desired color and physical characteristics. A fungicide, N-(Trichloromethylthio) phthalimide shall be added at the rate of 3 pounds per 100 gallons.

6. **Formula C-10-83 - Vinyl Finish Coat:**

Vinyl Finish Coat shall conform to the following Specifications:

- a. **Pigment (12 Percent Minimum by Weight)** - A combination of titanium dioxide and colored pigments or a combination of colored pigments such that the resultant paint when dry matches the color sample available at the SPU Materials Laboratory.
- b. **Vehicle (88 Percent Maximum by Weight).**

Vinyl Resin Type II ¹	9.1 parts
Vinyl Resin Type III ²	9.1 parts
Tricresyl Phosphate	3.4 parts
Methyl Isobutyl Ketone	39.2 parts
Toluene	39.2 parts
Total	100.0

¹Vinyl Resin Type II shall be hydroxyl containing vinyl chloride-acetate copolymer. It shall contain 89.5 to 91.5 percent (by weight) vinyl chloride, 2.0 to 5.5 percent vinyl acetate and 5.3 to 7.0 percent vinyl alcohol. It shall produce results in the specified formulations equal to the Bakelite Corporation Vinylite resin VAGH.

²Vinyl Resin Type III shall be a vinyl chloride-acetate co-polymer of medium average molecular weight and shall contain 85 to 88 percent vinyl chloride and 12 to 15 percent vinyl acetate by weight. It shall produce in the specified formulations results equal to Bakelite Corporation Vinylite resin VYHH.

Lampblack shall be ground in the Vinyl Finish Coat vehicle to yield a smooth well ground paint, Black Vinyl Tinting Paste, *acceptable* for tinting the Vinyl Finish Coat.

The Vinyl Finish Coat and Vinyl Tinting Paste shall be ground to a fineness of not less than 5 when testing in accordance with Federal Test Method Standard No. 141b, Method 4411.1.

Vinyl Thinner shall be composed of the following Materials:

Toluene	90 percent by volume
Methyl Isobutyl Ketone	10 percent by volume

The paints as received require thinning with from 20 to 35 percent by volume of Vinyl Thinner to maintain a wet spray.

7. **Formula D-1-57 - Aluminum Paint:**

Aluminum paste Type 2 Class B	2.0 pounds
Spar Varnish	1.0 gallon

Aluminum paint shall be mixed on the Job Site, and only enough for one Day shall be mixed at a time. The weighed amount of paste shall be placed in a suitable mixing container and the measured volume of vehicle then poured over it. The paste shall be incorporated by vigorous stirring with a paddle.

Test Requirements: Prior to mixing.

8. **Formula D-4-57 - Black Enamel:**

The enamel shall meet the requirements of Federal TT-E-529 Black Enamel, Synthetic, Semi Gloss.

Test requirements: This enamel will be sampled and tested in the ready-mixed form.

9. **Formula D-5-83 - White Guard Rail Paint (Alkyd Vehicle):**

Titanium dioxide (dry pigment)	28.1 parts
Zinc oxide (dry pigment)	10.9 parts
Fibrous magnesium silicate (dry pigment)	4.3 parts
Aluminum stearate (dry pigment)	0.5 parts
Alkyd vehicle	37.0 parts
24% lead naphthenate drier	0.4 parts
6% Cobalt naphthenate drier	0.2 parts
6% Manganese naphthenate drier	0.2 parts
Anti-skinning agent	0.2 parts
Mineral spirits	18.2 parts
Weight per gallon (minimum)	11.0 pound
Viscosity at 70°F.	80-90 K.U.
Nonvolatile content (minimum)	70.2%
Grind (minimum)	4
Hiding power (maximum scale reading)	30
Set to touch	4 hours
Dry hard	18 hours
Sag Index	7 min.
Test Requirements	Prior to shipment
Viscosity Adjustment	Mineral spirits shall be added at the factory to achieve the specified viscosity

This formula is to be used over primed or previously painted surfaces.

10. **Formula E-1-57 - White for Wood Structures:**

The Material shall conform to Federal TT-P-102, Class A.

Test Requirements: This paint will be sampled and tested in the ready-mixed form.

Primer: Turpentine may be added to the above paint in quantities not to exceed 1-1/2 pints per gallon of paint for use as a primer.

11. **Formula E-2-62 - Primer for Wood:**

The primer shall be a ready mixed priming paint for use over unpainted wood surfaces. It shall meet the requirements of Federal Specification TT-P-25 Primer, Paint, Exterior.

Test Requirements: This paint shall be sampled and tested in the ready mixed form.

12. **Formula F-3-64 - Orange Equipment Enamel:**

The enamel shall meet the requirements for Enamel, Alkyd, Gloss, Federal Specification TT-E-489, except that the Sag Index shall be seven minimum. The color, when dry, shall match that of Federal Standard No. 595, color 12246.

Test Requirements: When manufactured on Contract or Purchase Order for maintenance use, the enamel will be sampled and tested in the ready-mix form. No factory inspection will be required; however, a one pint sample representing the batch shall be submitted to the SPU Materials Laboratory for approval before use.

For factory application to individual items of new Equipment, samples of the enamel will not be required; however, the Equipment manufacturer shall match the color and certify the quality of enamel used.

13. **Formula H-1-83 - Primer for Concrete:**

Titanium dioxide	5.0 parts
Calcium carbonate	19.7 parts
Fibrous magnesium silicate	6.8 parts
Silica	6.8 parts
Spar varnish	52.3 parts
Mineral spirits	9.4 parts
Weight per gallon (minimum)	9.8 pounds
Drying time (for testing purposes only)	18 hours
Viscosity at 70° F	65-75 K.U.
Consistency:	The paint shall not thicken after manufacture to an extent sufficient to impair its brushing qualities.
Test Requirements:	Prior to shipment

14. **Formula H-2-83 - White Masonry Paint for Precast Curbs**

Titanium dioxide (dry pigment)	11.9 parts
Calcium carbonate (dry pigment)	25.6 parts
Mica (dry pigment)	7.4 parts
Diatomaceous silica (dry pigment)	7.0 parts
Bentone (body agent)	0.5 parts
Pliolite S5-A	8.0 parts
Chlorinated Paraffin 40%	4.0 parts
Chlorinated Paraffin 70%	4.0 parts
Aromatic brushing thinner	31.6 parts
Viscosity at 70°F	90-100 K.U.
Weight per gallon (minimum)	12.1 pounds
Drying time (for test purposes only)	18 hours
Test requirements	Prior to shipment

15. **Formula H-3-83 - Yellow Masonry Paint for Precast Curbs**

Titanium dioxide (dry pigment)	1.0 parts
Medium chrome yellow (dry pigment)	10.9 parts
Calcium carbonate (dry pigment)	25.6 parts
Mica (dry pigment)	7.4 parts
Diatomaceous silica (dry pigment)	7.0 parts
Bentone (body agent)	0.5 parts
Pliolite S5-A	8.0 parts
Chlorinated paraffin 40%	4.0 parts
Chlorinated paraffin 70%	4.0 parts
Aromatic brushing thinner	31.6 parts
Viscosity at 70°F	90-100 K.U.
Weight per gallon (minimum)	12.1 pounds
Drying time (for test purposes only)	18 hours
Test requirements	Prior to shipment

16. **Formula K-1-83 - Exterior Acrylic Latex Paint-White:**

This paint shall meet the requirements of Federal Specification TT-P-19, Paint, Acrylic Emulsion, Exterior, except that the viscosity shall be 75-85 K.U.

This paint may be used self-primed in multiple coats over salts treated wood and on interior and exterior masonry surfaces.

Test Requirements: This paint will be sampled and tested in the ready-mixed form.

17. **Formula K-2-83 - Traffic Signal Yellow Enamel:**

Traffic signal yellow enamel shall meet the provision of Federal Specification TT-E-489 - Enamel, Alkyd, Gloss - and shall match the color of "Standard Interstate Yellow".

18. **Paint Formulas – Moisture Cured Urethane Paint**18-A. **General**

The color of the coating system will be specified in the Contract.

Materials shall meet the requirements of those applicable Specifications in SSPC-PA1, "Shop, Field and Maintenance Painting", which are not in conflict with these Standard Specifications.

The coating system for the "Moisture Cured Urethane" painting process shall coat the steel surfaces with three single component moisture-cured polyurethane coats. The various coats of paint shall be applied in thicknesses as specified in this Section.

Coating Systems which have a maximum recoat window on primer of less than seven Days shall not be used. Coating systems for steel surfaces shall incorporate a primer capable of being applied at a relative humidity of up to 98 percent, and steel and air temperatures between 35°F and 110°F. The intermediate and top coats shall be full coverage with coating applied to all steel surfaces. All steel coating Materials shall be furnished by the same manufacturer and shall be compatible with one another. The Contractor shall provide a Manufacturer's Certificate of Compliance for approval at least 5 Working Days before the need arises stating:

- a) The coating Materials meet the Materials Specifications.
- b) The coating Materials in the coating system are compatible.

- c) The manufacturer has manufactured at least one coat of the coating Material in the coating system specified and furnished for the Project. Coating Materials for the other coats shall be from the manufacturer's product line and recommended for use in the coating system.

Application of coating Materials shipped to the Project Site will not be permitted until the coating Materials have been approved.

18-B. Above Ground Application

Paint supplied for the Project shall conform to the following requirements:

(1) Primer (Full Coverage)

Generic Type:	Zinc filled, single component, moisture-cured polyurethane
Vehicle Type:	Moisture Cured Polyurethane
Pigment Type:	Zinc Dust
Pigment content:	80% minimum zinc by weight in dry film
Volume Solids:	60% plus or minus 2%
Dry Film thickness:	3 mils minimum

All Primer shall be tinted sufficiently with color so as to easily distinguish the dry primer from the blast cleaned steel surface.

(2) Intermediate Coat (Full Coverage)

Generic Type:	Micaceous iron oxide filled, single component, moisture-cured polyurethane
Vehicle Type:	Moisture Cured Polyurethane
Pigment Type:	4.0 lbs/gal micaceous iron oxide
Volume Solids:	60% minimum
Finish:	Flat (Low Gloss)
Color:	Tinted to distinguish from Primer and Top Coat
Dry Film thickness:	3 mils minimum

(3) Top Coat (Full Coverage)

Generic Type:	Micaceous iron oxide filled, single component, moisture-cured, aliphatic polyurethane
Vehicle Type:	Moisture Cured Polyurethane
Pigment Type:	Micaceous iron oxide
Volume Solids:	60% minimum
Finish:	Flat (Low Gloss)
Dry Film thickness:	3 mils minimum

The Proportions of the tinting pigments shall be varied to closely match the color of the existing Structure. Three color chip options shall be submitted to the Engineer for a final tinting selection.

Steel coating products furnished for the Project shall be manufactured by the same manufacturer and shall be compatible with one another.

18-C. Below Ground Application

Paint supplied for the Project shall conform to the following requirements:

Surface Preparation: Per SSPC-10

(1) Primer (Full Coverage)

Generic Type:	Zinc filled, single component, moisture-cured polyurethane
Vehicle Type:	Moisture-cured polyurethane
Pigment Type:	Zinc dust
Pigment Content:	80% minimum zinc by weight in dry film
Volume Solids:	60% plus or minus 2%
Dry Film Thickness:	3 mils minimum

All primer shall be tinted sufficiently with color so as to easily distinguish the dry primer from the blast cleaned steel surface.

(2) Top Coat (Full Coverage)

Generic Type:	Single component, moisture-cured, urethane tar with micaceous iron oxide
Color:	Black
Solids by Volume:	61% plus or minus 2%
Flash Point:	> 90°F
Temperature Resistance:	Wet - 180°F continuous, Dry - 240°F continuous
Dry Film Thickness:	4.0 to 6.0 mils

Manufacturing: Steel coating products furnished for the Project shall be manufactured by the same manufacturer and shall be compatible with one another.

9-08.3 INSPECTION REQUIREMENTS - GENERAL

The manufacturer shall notify the Engineer of the date on which manufacture is started, and the Engineer shall have the right to inspect all details of the manufacturing process.

Quantities of 20 gallons or less of the above formulas will be accepted without inspection upon the notarized Manufacturer's Certificate of Compliance. This certificate shall contain a statement by the manufacturer to the effect that the Material meets the formula Specification, and shall include a list of materials and quantities used. One copy of the certificate shall accompany the paint when shipped and one copy with a sample of the paint shall be sent to the SPU Materials Laboratory. The paint may be used at once without further release from the SPU Materials Laboratory.

9-08.4 PROCESS OF MANUFACTURE

9-08.4(1) GENERAL

The following process of manufacture shall be used for each paint except aluminum paint. Pigments shall be ground thoroughly in appropriate portions of the specified vehicle to form a paste meeting the requirements set forth in Section 9-08.4(7).

The grinding shall be done in a mill approved by the Engineer. The use of the "colloid" type of mill will not be approved. Weighed quantities of the paste and weighed or measured quantities of the vehicles shall then be mixed thoroughly and strained, if necessary, to form a paint free from skins, lumps, and foreign materials.

9-08.4(2) VISCOSITY ADJUSTMENT

The volatile thinner content of the paint shall be adjusted at the factory to meet the required viscosity, but in no case shall the resultant weight per gallon and nonvolatile content of the paint be below that specified in the formula.

9-08.4(3) WEIGHT VARIATIONS

The weight per gallon of the paint in any lot shall not be less than that stated in the formula. A "lot" as used in this section shall be the quantity of paint ground at one time by any one mill.

9-08.4(4) DRYING TIME AND QUANTITY OF DRIER

The paint shall dry within the length of time stated in each formula but shall not contain sufficient quantities of drier to cause the paint to dry to a nonuniform or nonelastic film. The manufacturer will be permitted to vary the quantity of drier given in the formula sufficiently to accomplish the above results.

9-08.4(5) WORKING PROPERTIES

The paint shall contain no caked material that cannot be broken up readily by stirring. When applied to a clean vertical surface, the paint shall dry without running, streaking, or sagging.

9-08.4(6) STORAGE PROPERTIES

Paints manufactured under these Specifications shall show no skin over the surface after 48 hours in a partially filled container, when tested as outlined in Federal Test Method Standard No. 141. A slight amount of skin or gel formation where the surface of the paint meets the side of the container may be disregarded. Variable percentages of anti-skinning agents are shown in those formulas set forth above that are susceptible to undesirable skin formation. The manufacturer will be allowed to vary the amount of anti-skinning agent given in the formulas provided the above results are accomplished and provided the paint does not dry to a nonuniform or nonelastic film.

9-08.4(7) FINENESS OF GRINDING

The paint shall be ground so that all particles of pigment are dispersed and be coated with vehicle, and the residue on a 325 sieve does not exceed 1 percent by weight of the pigment.

9-08.4(8) STANDARD COLORS

When the paint is required to match a standard color, the manufacturer may obtain a sample of the required color without cost upon application to the Materials Laboratory.

9-08.4(9) CONTAINERS

Each container shall be filled with paint and sealed airtight. Each container shall be filled with the amount of paint required to yield the specified quantity when measured at 70°F.

All paint shall be shipped in new suitable containers having a capacity not greater than 5 gallons. Each container shall be marked with a suitable number to identify the particular batch from which it was filled.

9-08.5 TEST METHODS

As set forth in Section 9-08.2, all paints shall meet the special requirements set forth for each formula. The test methods used to check those special requirements shall be as specified by Federal Specification TT-P-141. When test methods are not covered by the above, applicable ASTM methods shall be followed.

9-08.6 SHIPPING

Except for lots of paint in quantities of 20 gallons or less which are accepted upon the Manufacturer's Certificate of Compliance, the manufacturer shall not ship any lot of paint until the paint has been tested and released by the Materials Laboratory. This release will not constitute final acceptance of the paint. *Final acceptance will be based on inspection or testing of Project Site samples.*

9-08.7 FIELD SAMPLES

Because of the volatility of the solvents used in the paint, the upper limit on viscosity will be waived on all paint samples taken in the field.

SECTION 9-09 TIMBER AND LUMBER**9-09.1 GENERAL REQUIREMENTS**

All timber and lumber for Structures shall be Douglas Fir-Larch, unless specified otherwise in the Contract. The allowable species of timber and lumber for guardrail posts shall be Douglas Fir-Larch or Hem Fir. Timber and lumber for sign posts, mileposts, sawed fence posts, and mailbox posts, shall be Western Red Cedar, Douglas Fir-Larch, or Hem Fir.

9-09.2 GRADE REQUIREMENTS

Timber and lumber shall conform to the grades and usage *as follows*. Grades shall be determined by the current standards of the West Coast Lumber Inspection Bureau (WCLIB) or the Western Wood Products Association (WWPA).

Structures

Timber and lumber, unless specified otherwise in the Contract, shall conform to the following:

Materials 2" to 4" nominal thick, 5" nominal and wider (Structural Joists and Planks)	No. 1 and better, grade (Section 123-b of WCLIB) or (Section 62.11 of WWPA)
Materials 5" nominal and thicker (Beams and Stringers)	No. 1 and better, grade (Section 130-b of WCLIB) or (Section 70.11 of WWPA)

Timber lagging for soldier pile walls shall be Douglas Fir-Larch, grade No. 2 or better.

Guardrail Posts

Timber and lumber for guardrail posts (classified as Posts and Timbers) shall conform to the grades *as follows*.

Douglas Fir	No. 1 and better, grade (Section 131-b WCLIB) or (Section 80.11 WWPA)
Hem Fir	Select Structural, grade (Section 131-a WCLIB) or (Section 80.10 WWPA)

Sign Posts, Mileposts, Sawed Fence Posts, and Mailbox Posts

Mileposts, sawed fence posts, and mailbox posts shall conform to the grades as follows:

4x4	Construction grade (Light Framing, Section 122-b WCLIB) or (Section 40.11 WWPA)
4x6	No. 1 and better, grade (Structural Joists and Planks, Section 123-b WCLIB) or (Section 62.11 WWPA)
6x6, 6x8, 8x10	No. 1 and better, grade (Posts and Timbers, Section 131-b WCLIB) or (Section 80.11 WWPA)
6x10, 6x12	No. 1 and better, grade (Beams and Stringers, Section 130b WCLIB) or (Section 70.11 WWPA)

Sign and parking meter posts shall meet the Material requirements specified in Section 9-28.2.

9-09.2(1) SURFACING AND SEASONING

All timber and lumber shall be sized as indicated on the Drawings.

All timber and lumber to be painted shall be surfaced on all sides. All timber and lumber to be painted shall be thoroughly air or kiln dried to an equilibrium moisture content and shall be stored in such a manner as to remain in a thoroughly dry condition until placed into the Work.

9-09.2(2) RESERVED**9-09.2(3) INSPECTION**

Timber and lumber shall be marked with a certified lumber grade stamp provided by one of the following agencies:

West Coast Lumber Inspection Bureau (WCLIB)
Western Wood Products Association (WWPA)
Pacific Lumber Inspection Bureau (PLIB)
Any lumber grading bureau certified by the American Lumber Standards Committee

A grading certificate shall accompany each order of timber and lumber for use in Structures as specified in Section 9-09.2. In consideration of being acceptable, the certificate shall be issued by either the grading bureau whose stamp is shown on the material, or by the lumber mill which is under the supervision of one of the grading bureaus listed above. The grading certificate shall include the following:

- Name of the mill performing the grading
- The grading rules being used
- Name of the person doing the grading with current certification
- Signature of a responsible mill official
- Date the lumber was graded at the mill
- Grade, dimensions, and quantity of the timber or lumber

When the Material is delivered to the Project, the Engineer will check the order for the appropriate grade stamp. The invoice and grading certificate accompanying the order shall be accurate and complete with the information listed above. The grading certificate and grade markings will not constitute final acceptance of the Material. The Engineer may reject any or all of the timber or lumber that does not comply with the Specifications or has been damaged during shipping or upon delivery.

9-09.3 PRESERVATIVE TREATMENT

All timber and lumber requiring preservative treatment shall be treated in accordance with AASHTO M 133. As specified by AASHTO M 133, the American Wood-Preservers' Association (AWPA) standards shall govern the specifications. These specifications include: storing and curing the timber and lumber, the wood preservatives, the preservative treatment process, documenting the results of the treatment, inspection, testing, and the identification of properly treated timber. Unless otherwise specified in the Contract, all timber and lumber shall be treated in accordance with Section C-14 of the latest addition of the AWPA standards.

All cutting, boring, chamfering, routing, surfacing, and trimming shall be done prior to treating. Any field drilling or cutoffs shall be treated by two liberal applications of compatible preservative. The applications shall be in accordance with the requirements of AWPA Standard M-4 entitled, "Standard for the Care of Pressured Treated Wood Products".

All charges shall consist of pieces of the same species that are similar in form, size, moisture content, and receptivity to treatment. The pieces in the charge shall be separated to ensure contact of treating medium with all surfaces. The method of determining the retention of the preservatives shall be by assay.

As specified in the Contract, all orders of treated timber and lumber shall be stamped "WSDOT Approved for Shipment" or accompanied by a Certificate of Treatment record. The Certificate of Treatment shall include the following information:

- Name and location of the wood preserving company
- Customer identification
- Date of treatment and charge number
- Type of chemical used and amount of retention
- Treating process and identification of the specification used
- Description of material that was treated
- Signature of a responsible plant official

In addition to the Certificate of Treatment, all orders of treated timber or lumber that are not stamped "WSDOT Approved for Shipment", shall be accompanied by a Grading Certificate in accordance with Section 9-09.2(3). Such certification or approved for shipment tag will not constitute final acceptance of the material. The Engineer may reject any or all of the timber or lumber that does not comply with the Specifications or has been damaged during prolonged storage, shipping, or upon delivery.

All timber and lumber to be used in aquatic environments, unless specified otherwise in the Contract, shall be chemically treated using Best Management Practices (BMPs). The producer of the chemically treated products shall supply a written certification that the BMPs were utilized, including a description and appropriate documentation of the BMPs used. This information may be included on the Certificate of Treatment record.

SECTION 9-10 PILING

9-10.1 TIMBER PILING

9-10.1(1) GENERAL

Timber piling shall be untreated or treated with the preservatives specified on the Drawings and completely described in Section 9-09.3.

Timber piles shall have the following limiting diameters:

Length in Feet	Min. Butt Dia. 3 ft. Above Butt (inch)	Max. Butt Dia. 3 ft. Above Butt (inch)	Min. Tip Dia. (inch)
Under 40	12	20	7
40 – 54	12	20	7
55 – 74	13	20	7
Over 74	14	20	7

Timber piles shall be strapped with at least three straps: one approximately 18 inches from the butt, one approximately 24 inches from the butt, and one approximately 12 inches from the tip. Additional straps shall be provided at approximately 15-foot centers between the butt and tip. Strapping shall encircle the pile once and be tensioned as tightly as possible. Straps shall be 1-1/4 inches wide, 0.031 inch thick, cold rolled, fully heat treated, high tensile strapping, painted, and waxed, with an ultimate tensile strength of 5,100 pounds. The seal shall be 2-1/4 inches long, 20 gage, crimped with a notch type sealer to furnish a joint yielding 80 percent of the strap tensile strength. Treated timber piles shall be strapped after treatment.

9-10.1(2) UNTREATED PILING

Except where specifically provided otherwise, untreated timber piling shall be Douglas fir, Western red cedar, or larch. Piling for foundations shall be Douglas fir. Piling shall be cut from sound, live trees and shall contain no unsound knots. Sound knots will be permitted, provided the diameter of the knot does not exceed 4 inches, or 1/3 of the small diameter of the pile at the point where they occur, whichever is smaller. Any defect or combination of defects that impair the strength of the pile more than the maximum allowable knot will not be permitted.

Piling shall be cut above the butt swell and shall have a uniform taper from butt to tip. A line drawn from the center of the tip to the center of the butt shall not fall outside the center of the pile at any point more than 1 percent of the length of the pile. A spiral grain or twist in excess of 1/4 turn in 10 feet of length will be cause for rejection.

Untreated timber trestle piling shall have an average of at least five annual rings per inch measured radially over a distance of 3 inches at the butt, beginning at a point 3-1/2 inches from the heart. At least 9 inches of heartwood shall show at the butt.

Ring count requirements for untreated timber foundation piling and detour trestle piling will be waived.

9-10.1(3) CREOSOTE TREATED PILING

For creosote treated piling, Douglas fir timber shall be used. All other requirements shall be the same as for untreated piling, except that the ring count requirement will be waived.

9-10.1(4) TIMBER COMPOSITE PILING

Timber composite piling shall consist of a pile made up of two timber sections. The lower section shall be untreated, and the upper section shall be creosote treated.

The treated and untreated sections of timber composite pile shall meet the respective requirements specified above for full length of treated and untreated timber piling.

9-10.1(5) PEELING

Untreated and creosote treated piles shall be peeled by removing all of the rough bark and at least 80 percent of the inner bark. No strip of inner bark remaining on the pile shall be over 3/4 inch wide or over 8 inches long, and there shall be at least 1 inch of clean wood surface between any two such strips. Not less than 80 percent of the surface on any circumference shall be clean wood. All knots shall be trimmed close to the body of the pile.

9-10.2 CONCRETE PILING

9-10.2(1) CONCRETE

Portland cement meeting the requirements of Section 9-01 shall be used in all precast concrete piles.

The concrete for precast-prestressed piles shall conform to the requirements of Section 9-19. The concrete for prestressed piles shall have a minimum compressive strength of 6,000 psi at the age of 28 Days. The minimum compressive strength of concrete at the transfer of prestress shall be 3,300 psi.

The concrete for other precast piles shall be Class AX. Mixing, transporting, and placing concrete shall be in accordance with the provisions of Section 6-02.3.

The Contractor shall mold and test a sufficient number of concrete test cylinders to determine the strength of the concrete as required by the Specifications. Under the surveillance of the Engineer, the test cylinders shall be molded, cured, and tested in accordance with the procedures established by the Materials Laboratory.

In the event that a sufficient number of concrete test cylinders are not molded to satisfy all testing required on any one pile, cores measuring 4 inches in diameter by 5 inches in height shall be taken and tested by the Contractor. If the strength of the core meets the required compressive strength of the concrete, the pile may be accepted. The coring and testing of the core shall be done under the surveillance of the Engineer.

9-10.2(2) REINFORCEMENT

Reinforcement shall meet the requirements of Section 9-07.

9-10.3 CAST-IN-PLACE CONCRETE PILING**9-10.3(1) REINFORCEMENT**

Reinforcement for cast-in-place concrete piles shall conform to the requirements of AASHTO M 31, Grade 60.

9-10.4 STEEL PILE TIPS AND SHOES

Steel pile tips and shoes shall be fabricated of cast steel conforming to ASTM A 148, Grade 60-90 [620-415] or ASTM A 27, Grade 65-35 [450-240] and be free from any obvious defects. Pile tips shall be accompanied by a mill test report stating the chemical and physical properties (tensile and yield) of the steel.

9-10.5 STEEL PILING

The Material for steel piling and pile splices shall conform to ASTM A 36, except the Material for steel pipe piling, and splices shall conform to the requirements of ASTM A 252, Grade 2. All steel piling may be accepted by the Engineer based on the Manufacturer's Certificate of Compliance.

SECTION 9-11 WATERPROOFING**9-11.1 ASPHALT FOR WATERPROOFING**

Asphalt for waterproofing shall conform to the requirements of ASTM D 312, Type 4.

The Material used as primer shall conform to the requirements of ASTM D 41, "Primer for Use with Asphalt in Dampproofing and Waterproofing".

Acceptance shall be as provided in Section 9-02.2(1).

9-11.2 WATERPROOFING FABRIC

Waterproofing fabric shall be a saturated cotton fabric meeting the requirements of ASTM D 173, "Woven Cotton Fabrics Saturated with Bituminous Substances for Use in Waterproofing".

9-11.3 PORTLAND CEMENT MORTAR

Portland cement and *fine* sand for the mortar protection course shall conform to the following requirements:

Portland Cement	Section 9-01
Sand	Section 9-03.1(2)C

SECTION 9-12 MANHOLES, CATCH BASINS, AND INLETS**9-12.1 REINFORCED CONCRETE****9-12.1(1) GENERAL**

Reinforced concrete shall consist of Portland cement, fine and coarse aggregates and water, in which steel has been embedded in such manner that the steel and concrete act together.

All cast-in-place concrete placed under these Standard Specifications shall be Class AX (see Section 6-03.3(2)). Strength determination shall be in accordance with ASTM C 39. Precast components shall conform to the strength requirements of ASTM C 478.

The use of admixtures shall require prior approval of the Engineer. Concrete with air-entraining admixture shall comply with ASTM C 175.

9-12.1(2) CEMENT

Portland cement shall conform to the requirements of Section 9-01.

9-12.1(3) STEEL REINFORCEMENT

Reinforcement shall consist of wire conforming to ASTM A 82 or ASTM A 496, or wire fabric conforming to ASTM A 185 or ASTM A 497, or Grade 60 steel bars conforming to ASTM A 615 or Grade 80 steel bars conforming to ASTM A 306.

9-12.1(4) AGGREGATES

Aggregates for cast-in-place concrete shall conform to ASTM C 33.

9-12.2 STEPS, HANDHOLDS, AND LADDERS**9-12.2(1) GENERAL**

The Material for manhole steps, ladders, and handholds shall be at the Contractor's option from the choices indicated in the following subsections and shall be the same material in any individual drainage Structure. See Section 7-05.3(1)Q for submittal requirement. Dimensions and layout shall conform to Standard Plan no. 232. Size of components shall conform to Standard Plan no. 232 unless the subsections following in Section 9-12.2 indicate other sizes for specific Materials.

9-12.2(2) ALUMINUM

Aluminum steps shall be forged of 6005-T5 alloy having a minimum tensile strength of 38,000 psi. The cross section shall be not less than 3/4 inch wide by 7/8 inch deep with two non-skid grooves not to exceed 1/8 inch deep and 1/8 inch wide.

9-12.2(3) GALVANIZED DEFORMED REINFORCING STEEL

Galvanized deformed bar steps shall be deformed reinforcing steel conforming to ASTM A 615, Grade 40 or Grade 60, hot bent and galvanized after bending. For bending, the temperature shall be at least 1600°F. Galvanizing shall conform to ASTM A 123.

9-12.2(4) POLYPROPYLENE ENCAPSULATED REINFORCING STEEL

Polypropylene steel reinforced steps shall be made of copolymer polypropylene plastic that encapsulates a 1/2 inch diameter grade 60 steel reinforcing steel. Steel reinforcing shall conform to the requirements of ASTM A 615, and copolymer polypropylene plastic shall conform to requirements of ASTM D 4101. Steps shall have serrated tread, measure 13 inches center to center between legs of the step, and be designed to withstand pullout forces of 1500 pounds.

The Contractor may, with the Engineer's approval, use "Plastic Manhole Steps" manufactured by Lane International Corporation, or "Steps" manufactured by M.A. Industries, Inc.

9-12.2(5) COPOLYMER POLYPROPYLENE PLASTIC

Steps and ladders made of copolymer polypropylene plastic, as manufactured by Lane International Corp., or M.A. Industries, Inc., or by another manufacturer with equal Material, will be acceptable.

9-12.3 RESERVED**9-12.4 MORTAR AND GROUT FOR SEWER AND DRAINAGE STRUCTURES****9-12.4(1) MORTAR FOR JOINTS**

Mortar for jointing precast or masonry manhole, catch basin, or inlet units shall be one part Portland cement to not less than one part nor more than two parts plaster sand, mixed with the least amount of clean water necessary to provide a workable mortar. Joints between precast manhole elements shall also be rubber gasketed as noted in Section 7-05.3(1)K.

9-12.4(2) MORTAR FOR PLASTER-COATING

Mortar for plaster-coating or lining masonry unit manholes shall be proportioned according to either of the two alternates tabulated as follows:

Alternate	Parts by volume Portland cement	Parts by volume Masonry cement	volume hydrated lime or lime putty	Plaster sand measured in damp loose condition
1	1	1 (Type II)	0	Not less than 2-1/4 and not more than 3 times the sum of volumes of cement and lime
2	1	0	1/4	

9-12.4(3) GROUT

Grout for filling the void in Sewer and Drainage Structures where pipe connections are made shall be non-shrink cement sand grout complying with the requirements of Section 9-04.3(2).

9-12.5 CONCRETE MASONRY UNITS

Concrete masonry unit (also called concrete masonry block) shall conform to ASTM C 139, "Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes", except that nominal horizontal thickness shall be 6 inches measured radially, and blocks shall have semicircular mortar grooves approximately 1 inch radius at the ends.

9-12.6 CONCRETE BRICK

Concrete brick shall conform to the Specifications for Concrete Building Brick ASTM C 55, Grade S.

9-12.7 CLAY BRICK

Clay brick shall conform to ASTM C 32, Grade MM unless otherwise specified in the Contract.

9-12.8 METAL CASTINGS**9-12.8(1) MANHOLE RING AND COVER**

Ring and cover casting dimensions shall conform to the Standard Plans. Rings and ring extensions shall be manufactured from cast iron ASTM A 48, Class 30 or ductile iron ASTM A 536, Grade 80-55-06. Covers shall be manufactured from ductile iron ASTM A 536, Grade 80-55-06. Rings and covers shall be free of defects such as porosity, pittings, shrink cavities, cold shuts, cracks, and other surface defects which would impair serviceability. Repair of defects by welding or by the use of "smooth-on plasticized metals" or similar Material will not be accepted. Manufacturer shall certify that the product conforms to the requirements of these Specifications. In accordance with Section 1-06.1, where source of Material is different from manufacturer, the Contractor shall also provide the name and location of the manufacturer.

Castings shall be bare metal. Artificially coated or painted castings will be cause for rejection.

Castings shall be machine finished on the horizontal seating surface and the vertical facing surface common to the ring and cover, so as to assure full bearing (nonrocking) for the entire width and circumference of the bearing surface, and permit interchangeability with other castings of the same design, no matter what the source. The vertical face common to the ring and cover shall be beveled as shown on the Standard Plans. Upon request of the Engineer, the manufacturer shall furnish at the foundry standard ring and covers for use by Inspectors in testing fit and seating.

All covers shall be labeled with the following information:

1. Name or symbol of the manufacturer;
2. Owner's name (City of Seattle, min. 1/2 inch letters recessed flush with adjacent surface);
3. Material label "DUC" for Ductile Iron;
4. Identification of its use in 3 inch high lettering (Sewer, Drain, etc.);
5. Country of manufacture/origin.

Items 2. and 4. shall be on the exposed face of the cover. Items 1., 3., and 5. shall be located at the manufacturer's option. If located on the exposed face of the cover, item 1. and 3. shall be adjacent to each other and shall be set in at least 1/2 inch high recessed letters. Where lock-type castings are called for, a locking device shall permit the cover to be readily released from the ring. Movable parts shall be made of non-corrosive metals and be designed to avoid possible binding. Upon request by the Engineer, the manufacturer shall furnish testing apparatus at the foundry capable of applying uplift pressure on the lid of at least 20 foot head of water which the assembly needs to withstand without failure.

All manhole rings shall be labeled with the name or symbol of the manufacturer and the type of Material.

Where additional depth to a Standard Plan no. 230 frame is required, Standard Plan no. 231 ring extensions shall be securely bonded to the frame by epoxy at the manufacturer's facility. The Contractor shall provide a Manufacturer's Certificate of Compliance verifying this prior to installing the built up frame at the Project Site.

9-12.8(2) METAL FRAME AND GRATE AND METAL COVER FOR CATCH BASINS OR INLETS

The frame and grate and metal cover shall conform to the Standard Plans.

The frame may be made of cast iron, ASTM A 48, Class 30, or ductile iron, ASTM A 536, Grade 80-55-06, at the manufacturer's option. The grate and cover shall be made of ductile iron only. Other applicable provisions of Section 9-12.8(1) shall apply, except item (4) for identification marking.

Catch Basins, Type 242A and 242B and Inlets, Type 250A and 250B shall be furnished with a vaned grate as indicated on Standard *Plan* nos. 265 and 266.

9-12.8(3) CAST METAL INLETS

The castings for cast metal inlets shall be cast steel or ductile iron as specified in Section 9-06.8 or Section 9-06.14 and as shown in WSDOT Standard Plan no. B-4. *Substitutions may be accepted (see Section 1-06.1). Vaned grates shall be embossed as indicated on Standard Plan no. 264.*

9-12.9 JUNCTION BOX

Junction box shall comply with Standard Plan no. 277 and rebar shall be as shown in WSDOT Standard Plan no. B-1.

9-12.10 SHOP FABRICATED CORRUGATED METAL MANHOLES

Where corrugated metal manholes are specified, they shall be as shown on the Drawings and shall conform to the details as shown on the Drawings. The base Material and gage, and coating if required, shall be as shown on the Drawings. All pipe connections to the manhole stubs shall be made with a standard band type as shown on the Drawings.

See Section 7-16.2 for restrictions on the use of corrugated metal pipe flow control systems and detention systems in landslide-prone areas, and for pipe to be maintained by the City in landslide-prone areas.

9-12.11 MONOLITHIC CONCRETE MANHOLES

Monolithic concrete manholes shall conform to the Standard Plans.

9-12.12 OUTLET TRAPS

Outlet traps shall be constructed in accordance with Standard Plan no. 267a.

Catch basin traps shall be constructed in accordance with Standard Plan 267b (see Section 7-05.3(2)B).

9-12.13 GRATE INLETS AND DROP INLETS

Steel in grates, angles, and anchors for grate inlets and drop inlets shall conform with AASHTO M 183, except structural tube shall conform with ASTM A 500, Grade B. After fabrication, the steel shall be hot-dip galvanized with a minimum coating of 2 ounces of zinc per square foot in accordance with AASHTO M 111 or galvanized with a hot-sprayed (plasma flame applied) 6 mil minimum thickness zinc coating.

Steel grating shall be fabricated by weld connections. Bearing bars and cross bars shall be resistance welded at the intersecting joints. Welds, welding procedures, and welding Materials shall conform to Standard Specifications for Welding issued by the American Welding Society.

Vaned grates shall be embossed as indicated on Standard Plan no. 264.

Substitution of grate designs will be permitted, with the approval of the Engineer, provided the hydraulic capacity is not decreased, the overall dimensions are the same allowing the grate to be interchangeable, and the strength is *at least equal* to the grate shown in the Standard Plans unless indicated otherwise in the Contract. *The Contractor shall comply with the "or equal" requirements indicated in Section 1-06.1.*

The Contractor has the option of furnishing either cast-in-place or precast inlets unless otherwise shown in the Contract. Alternate designs are acceptable provided they conform to fabricator's Shop Drawings approved prior to Award of Contract.

SECTION 9-13 RIPRAP, QUARRY SPALLS, AND SLOPE PROTECTION**9-13.1 GENERAL**

The stone for riprap and quarry spalls shall be hard, sound and durable. It shall be free from segregation, seams, cracks, and other defects tending to destroy its resistance to weather. Riprap and quarry spalls used for new rock facing or slope stabilization shall meet requirements in Section 9-03.17.

9-13.2 LOOSE RIPRAP

Loose riprap shall be free of rock fines, soil, or other extraneous material.

Should the riprap contain insufficient 4" to 8" spalls, as defined in Section 9-13.7, the Contractor shall furnish and place supplementary spall material from a source approved by the Engineer, at the Contractor's expense.

The grading of the riprap will be determined by the Engineer by visual inspection of the load before it is dumped into place, or, if so ordered by the Engineer, by dumping individual loads on a flat surface and sorting and measuring the individual rocks contained in the load.

9-13.2(1) HEAVY LOOSE RIPRAP

Heavy loose riprap shall meet the following requirements for grading:

	Minimum Size	Maximum Size
40% to 90%	1 ton (1/2 cubic yd.)	
70% to 90%	300 lbs. (2 cu. ft.)	
10% to 30%	3 inch	50 lbs. (spalls)

9-13.2(2) LIGHT LOOSE RIPRAP

Light loose riprap shall meet the following requirements for grading:

	Size Range	Maximum Size
20% to 90%	300 lbs. to 1 ton (2 cu. ft. to 1/2 cu. yd.)	
15% to 80%	50 lbs. to 1 ton (1/3 cu. ft. to 1/2 cu. Yd.)	
10% to 20%	3 inch	50 lbs. (spalls)

9-13.3 HAND PLACED RIPRAP

Hand placed riprap shall be as nearly rectangular as possible, 60 percent shall have a volume of not less than 1 cubic foot. No stone shall be used which is less than 6 inches thick, nor which does not extend through the wall.

9-13.4 SACK RIPRAP

Sack riprap shall consist of concrete placed in sacks made of at least 10 ounce burlap and having a capacity of approximately 2.5 cubic feet. Each sack shall be filled with approximately 1 cubic foot of concrete having a consistency in conformance with Section 6-02.3(4)E for nonvibrated concrete.

For sack riprap exposed to fresh water, the concrete shall be Class C; and for sack riprap exposed and salt water, the concrete shall be Class B as specified in Section 6-02.3.

The *Portland* cement and fine and coarse aggregates shall conform to the requirements for *Portland* cement and fine and coarse aggregate of Sections 9-01 and 9-03.1, respectively.

9-13.5 RESERVED**9-13.6 CONCRETE SLOPE PROTECTION****9-13.6(1) GENERAL**

Concrete slope protection shall consist of reinforced Portland cement concrete poured or pneumatically placed upon the slope with a rustication joint pattern or semi-open concrete masonry units placed upon the slope closely adjoining each other.

9-13.6(2) SEMI-OPEN CONCRETE MASONRY UNITS SLOPE PROTECTION

Precast cement concrete blocks shall conform to the requirements of ASTM C 90, Type II.

9-13.6(3) POURED PORTLAND CEMENT CONCRETE SLOPE PROTECTION

Cement concrete for concrete slope protection shall be Class B in conformance with Section 6-02.3.

Wire mesh reinforcement shall conform to Section 9-07.7.

9-13.6(4) PNEUMATICALLY PLACED PORTLAND CEMENT CONCRETE SLOPE PROTECTION

Cement: This Material shall be Portland cement as specified in Section 9-01.

Aggregate: This Material shall meet the requirements for fine aggregate as specified in Section 9-03.1. The moisture content of the fine aggregate at the time of use shall be between 3 percent and 6 percent by weight.

Reinforcement: Wire mesh reinforcement shall conform to the provisions of Section 9-07.7.

Water: Water shall conform to the provisions of Section 9-25.1.

9-13.7 QUARRY SPALLS

The spall shall be hard, sound, and durable. It shall be free from fracture, seams, cracks, and other discontinuities tending to adversely impact its resistance to weathering. The quarry spall shall meet the 5 test requirements listed in Section 9-03.17. Quarry spalls shall meet the following gradation requirements:

2 INCH TO 4 INCH QUARRY SPALL

Sieve Size	Percent Passing
4 inch	100
2 inch	40 max.
1-1/4 inch	5 max.

4 INCH TO 8 INCH QUARRY SPALL

Sieve Size	Percent Passing
8 inch	100
4 inch	40 max.
2 inch	5 max.

All percentages are by weight.

SECTION 9-14 EROSION CONTROL AND ROADSIDE PLANTING**9-14.1 SOIL****9-14.1(1) TOPSOIL TYPE A**

The topsoil shall be imported and shall be friable surface soil from the A horizon as determined by the United States Agriculture Soil Conservation Service Soil Survey. Topsoil shall be free from: Materials toxic to plant growth; noxious weed seeds, rhizomes, roots; subsoil; stones and other debris. All topsoil shall pass through a 1 inch screen. Maximum electrical conductivity shall be 2.0 milliohms and the maximum exchangeable sodium percentage shall be 10 percent.

Topsoil Type A shall consist of a sandy clay loam, sandy loam, loam, clay loam, silty clay loam, or silt loam soil. These soil textural classes shall be determined by the United States Department of Agriculture Classification System. These textural classes shall be restricted by the following maximum percentage compositions based on the Material passing the Number 10 screen:

Separates	Maximum Percentage Allowable
Sand	50%
Clay	20%

The maximum percentage retained on a 1/4 inch screen shall not exceed 20 percent by volume. Of the Material passing the 1/4 inch screen, the maximum allowable percentage of gravel retained on a Number 10 screen shall not exceed 10 percent by weight. Total organic matter shall be at least 10 percent by volume. Organic matter shall be determined by the Walkley-Black sulfuric acid dichromate digestion process. The pH shall be 5.5 to 7.5.

9-14.1(2) TOPSOIL TYPE B

Topsoil Type B shall be native topsoil taken from within the Project Site, either from the area where roadway excavation is to be performed or from strippings from borrow, pit, or quarry sites, or from other designated sources. *The general limits of the Material to be utilized for topsoil will be indicated in the Contract.* The Engineer will make the final determination of the areas where the most suitable Material exists within these general limits. The Contractor shall reserve this Material for the specified use. The depth of excavation into existing surface soils for obtaining Topsoil Type B shall be determined in the field by the Engineer.

In the production of Topsoil Type B, all vegetative matter, except large brush and trees over 4 feet in height, shall become a part of the topsoil. Prior to removal, the Contractor shall mow or otherwise reduce the height of the native vegetation such as sagebrush, snowberry, etc., to be a height not exceeding 1 foot. *Noxious weeds, as designated by authorized State and County officials, shall not be incorporated in the topsoil, but shall be removed and disposed of.* The designated depth of Material shall then be taken from the designated areas and placed at locations which do not interfere with the construction of the Project as approved by the Engineer. The Contractor shall take all precautions to avoid disturbing the existing ground beyond the Project Site or slope stakes or other areas designated by the Engineer.

Topsoil Type B will not be considered as selected Material as defined in Section 2-03.3(10), and the conditions of said Section will not apply.

9-14.1(3) RESERVED**9-14.1(4) PLANTING SOIL AND PLAYFIELD SOIL****9-14.1(4)A PLANTING SOIL**

Description:

Planting soil shall consist of 67% sandy loam and 33% composted organic material by volume.

A. The soil shall meet the following requirements:

- Soil shall be sandy loam or loamy sand consisting largely of sand, but with enough silt and clay present to give it a small amount of stability. Individual sand grains can be seen and felt readily. On squeezing in the hand when dry, it shall fall apart when the pressure is released; on squeezing when moist, it shall form a cast that does not only hold its shape when the pressure is released, but shall withstand careful handling without breaking.

The mixed soil shall meet the following gradation:

Screen Size	Percent Passing
1/2 inch	100
1/4 inch	95 – 100
#10	85 – 95
#30	60 – 75
#60	50 – 60
#100	20 – 30
#200	5 – 15

- B. Shall have a pH range of 5.5 - 7.5. *Soils indicated having a pH below 5.5 shall be treated with dolomitic limestone as necessary to attain this pH range. Soils having a pH greater than 7.5 shall be treated with sulfur as necessary to attain this pH range. The pH shall be determined by soil test.*
- C. Organic material shall consist of composted yard debris or organic waste material composted for a minimum of 3 months. Compost shall consist of 100% recycled content.
In addition, the organic material shall have the following physical characteristics:
 - 1. Shall pass a standard cress test for seed germination (90% germination compared to standard).
 - 2. Shall have a pH from 5.5 to 7.5.
 - 3. Shall have a maximum electrical conductivity of 3.0 ohms/cm.
 - 4. Shall have a maximum carbon to nitrogen ratio of 40:1.
 - 5. Shall be certified by the Process to Further Reduce Pathogens (PFRP) guideline for hot composting as established by the United States Environmental Protection Agency.
- D. *Submit a certified laboratory analysis from an accredited soils testing laboratory indicating the Material source and compliance with all planting soil Specifications to the Engineer for approval before delivery to the Project Site. The analysis shall be with a sample size of no less than 2 pounds.*
- E. Site specific soil testing (after placement of material) may be required for Projects requiring more than 50 cubic yards of planting soil. *A Contractor provided accredited laboratory approved by the Engineer shall make recommendations for amendments required for optimum growth at no cost to the Owner. The Contractor will be allowed 4 Working Days to complete the testing from the time of Written Notice given by the Engineer.*

Acceptable Sources:

- 1. Astec, LLC, Bellevue, WA
- 2. Cedar Grove Compost Company, Maple Valley, WA
- 3. Northwest Cascade, Puyallup, WA
- 4. Pacific Topsoils, Inc., Everett, WA
- 5. Other approved equal.

(For other available sources refer to the current edition of "Directory of Recycled Content Building and Construction Products" as published by the Clean Washington Center, Department of Trade and Economic Development, 2001 Sixth Avenue, Suite 2700, Seattle, Washington 98121, Phone Number 206-443-7723.)

9-14.1(4)B PLAYFIELD SOIL

Description:

Playfield Soil shall consist of 2/3 sand and 1/3 composted organic material by volume.

- A. Sand shall meet the following:

Size	Sieve	Percent Passing
3/8	ASTM E-11	100
No. 20	ASTM E-11	77 – 100
No. 60	ASTM E-11	0 – 23
No. 270	ASTM E-11	0 – 10

- B. Shall have pH range of 5.0 - 6.5. *Soils indicated having a pH below 5.0 shall be treated with dolomitic limestone as necessary to attain this pH range. Soils having a pH greater than 6.5 shall be treated with sulfur as necessary to attain this pH range. The pH shall be determined by soil test.*
- C. Organic material shall consist of composted yard debris or organic waste material, and shall consist of 100% recycled content. In addition, the organic material shall have the following physical characteristics:
 - 1. Shall pass a 3/4 inch sieve.
 - 2. Shall pass a standard cress test for seed germination (90% germination compared to standard).
 - 3. Shall have a pH from 5.5 to 7.5.
 - 4. Shall have at least 25% organic matter by dry weight.
 - 5. Shall have a maximum electrical conductivity of 3.0 mhos/cm.
 - 6. Shall have a maximum carbon to nitrogen ration of 40:1.
 - 7. Shall be certified by the "Process to Further Reduce Pathogens" (PFRP) guideline for hot composting as established by the United States Environmental Protection Agency.
 - 8. Composted material shall be fully mature and stable before usage (2 pound minimum size samples required).
- D. Submit a certified laboratory analysis from an accredited soils testing laboratory indicating the Material source and compliance with all specifications to the Engineer for approval prior to delivery to the Project Site. Sample size shall be a minimum of 2 pounds.

Acceptable Sources:

- 1. ASTEC, LLC, Bellevue, WA
- 2. Northwest Cascade, Puyallup, WA

3. Cedar Grove Compost Company, Maple Valley, WA
4. Pacific Topsoils, Inc., Everett, WA
5. Other approved equal:

(For other available sources, refer to the current edition of the "Directory of Recycled Content Building and Construction Products" as published by the Clean Washington Center, Department of Trade and Economic Development, 2001 6th Avenue, Suite 2700, Seattle, Washington 98121; Telephone Number 206-443-7723.)

9-14.2 SEED

9-14.2(1) GENERAL

Grasses, legumes, or cover crop seed of the type specified shall conform to the standards for "Certified" grade seed or better as outlined by the State of Washington Department of Agriculture "Rules for Seed Certification", *current* edition. Seed shall be furnished in standard containers on which shall be shown the following information:

1. Common name of seed,
2. Lot number,
3. Net weight,
4. Percentage of purity,
5. Percentage of germination (in case of legumes percentage of germination to include hard seed), and
6. Percentage of weed seed content and inert material clearly marked for each kind of seed in accordance with applicable State and Federal law.

Upon request, the Contractor shall furnish to the Engineer duplicate copies of a statement signed by the *Materialman* certifying that each lot of seed has been tested by a recognized and accredited seed testing laboratory within six months before the date of delivery on the Project. Seed which has become wet, moldy, or otherwise damaged in transit or storage will not be accepted.

Approved Varieties:

- A. Turf-type Perennial Rye-grass Blend

Blend shall consist of at least two of the following varieties and mixed in equal portions by weight:

Commander	Brightstar	Palmer II	Nighthawk
Blazer II	Prelude II	Assure	Tara
Fiesta II	SR 4200	Prizm	Affinity
Stallion Sel	Dimension	APM	Charger
Satum	Sherwood	Birdie	SR 4100

- B. Creeping Red Fescue

A single variety *shall* be selected from the list immediately following:

Cindy	Ensylva	Flyer
Salem	Jasper	-----

- C. Chewings Fescue

A single variety *shall* be selected from the list immediately following:

Longfellow	Promoter	Victory	Weekend
Shadow w/Endo	Southport	Tamara	Bridgeport
Waldorf	Enjoy	Bargreen	-----

9-14.2(2) SEED MIX #1 (EROSION MIX)

The seed mixture and rate of application shall be as follows:

Kind and Variety of Seed in Mixture	Percent by Weight
Turf-type Perennial Rye (3 approved types)	50%
Creeping Red Fescue	20%
Chewings Fescue	20%
Hard Fescue	10%

The rate of application shall be 5 pounds per 1000 square feet. The seed mixture shall be no less than 98% pure, and shall have a minimum germination rate of 90%.

9-14.2(3) SEED MIX #2 (NON-IRRIGATED LAWN SEED MIX)

The seed mixture and rate of application shall be as follows:

Kind and Variety of Seed in Mixture	Percent by Weight
Turf-type Perennial Rye (3 approved types)	50%
Chewings Fescue	30%
Hard Fescue	20%

The rate of application shall be 6 pounds per 1000 square feet. No noxious weeds will be permitted. The seed mixture shall be no less than 98% pure, and shall have a minimum germination rate of 90%.

9-14.2(4) SEED MIX #3 (IRRIGATED LAWN OR ATHLETIC PLAYFIELD)

The seed mixture and rate of application shall be as follows:

Kind and Variety of Seed in Mixture	Percent by Weight
Turf-type Perennial Rye Grasses (choose any 3 of the following approved types)	100%

Barry	Elka	Palmer	Derby
Blazer	Gator	Prelude	Omega
Citation	Loretta	Regal	Omega II
Citation II	Manhattan II	Yorktown II	Diplomat

The rate of application shall be 8 pounds per 1000 square feet. No noxious weeds will be permitted. The seed mixture shall be no less than 98% pure, shall have a minimum germination rate of 80%, and shall have no more than 0.5% weed seed.

All seed varieties shall be packed in separate, clean, sound containers of uniform weight. The Contractor shall deliver the seed to the Job Site in the original containers showing weight, analysis, and name of grower, and shall store in a manner that prevents all wetting and deterioration of seed, until the seed is approved, mixed and sown.

9-14.2(5) SEED MIX #4 (BIOFILTRATION SWALE MIX)

The seed mixture and rate of application shall be as follows:

Kind and Variety	Percent by Weight
Turf-type Perennial Rye*	40%
Turf-type Tall Fescue	20%
Meadow Foxtail	20%
Hard Fescue	10%
Big Trefoil	5%
Seaside Creeping Bentgrass*	5%

The rate of application shall be 10 pounds per 1000 square feet.

**The mix indicated above shall be applied to areas associated with sea water. In areas not associated with sea water, Seaside Creeping Bentgrass shall not be included in the mix (0%) and the percentage of Turf-type Perennial Rye shall be increased from 40% to 45%. This requirement will be indicated on the Contract Drawings.*

Biofiltration Swale Mix shall be applied as described in Section 9-14.4(2) for terrain steeper than 2H:1V with tackifier (see Section 9-14.4(8)). Fertilizer utilized in seeding biofiltration swales shall be as specified in Section 9-14.3(1) with 75% of nitrogen supplied as methylene urea for slow release.

9-14.2(6) WILDFLOWER MIX

The seed mixture and rate of application shall be as follows:

Wildflower Mix:

Kind and Variety	Percent by Weight
Turf Type Perennial Rye (3 types)	45%
Chewings Fescue	25%
Hard Fescue	15%
Wildflowers	15%

The Contractor shall submit, and receive approval from the Engineer at least 3 Working Days before ordering, all species included in the wildflower mix and the Materialman's written directions on how to apply the seed mix. Written directions shall include rate of application and the incorporation of specific species of grass seed components when appropriate to the achieve adequate erosion control protection while maximizing flower display and regeneration.

Wildflower seed mix shall have a minimum of 20 wildflower species and shall not contain more than 10% (by weight) of any single species. The seed mix shall be no less than 98% pure and shall have a minimum germination rate of 90%.

Noxious weeds (Chapter 16-750 WAC), and invasive species listed by the Washington State Noxious Weed Control Board, will not be allowed. The following list of invasive species will be considered as noxious weeds:

annual coreopsis (coreopsis tinctoria)
baby blue eyes (nemophila menziesii)
baby's breath (gypsophila elegans)
bachelor's button (centaurea cyanus)
black-eyed susan (rudbeckia hirta)
blue flax (linum perenne)
california poppy (eschscholzia californica)
common yarrow (achillea millefolium)
cosmos (cosmos bipinnatus)
cow cockle (vaccaria hispanica)

crimson clover (trifolium incarnatum)
dame's rocket (hesperis matronalis)
fireweed (chamerion angustifolium)
forget-me-not (mysotis sylvatica)
poor man's weatherglass (anagallis arvensis)
redroot pigweed (amaranthus retroflexus)
sweet alyssum (lobularia maritima)
wild lupine (lupinus perennis)
yellow toadflax (linaria vulgaris)

Mixes shall be applied in accordance with manufacturers written directions submitted for Engineers approval a minimum of 2 *Working Days* prior to application. Written directions shall include rate of application and the incorporation of specific species of grass seed components when appropriate to the achieve adequate erosion control protection while maximizing flower display and regeneration.

Wildflower seed mix shall have a minimum of 20 wildflower species and shall not contain more than 10% (by weight) of any single species. No noxious weeds will be permitted. The seed mix shall be no less than 98% pure and shall have a minimum germination rate of 90%. *Approved sources of wildflower mixes are:*

1. "Bloomers"
Turf Seed
Hubbard, OR
Phone (503) 651-2130
web-site www.turf-seed.com (*Information and ordering*)
2. "Pacific Northwest Wildflower"
Environmental Seeds
Lompoc, CA
(*order by phone, by FAX, or by e-mail*)
Phone (805) 735-8888
FAX (805) 735-8798
E-mail esp@espseeds.com
web-site: www.espseeds.com (*Information only*)
3. *United Agro Products NW (dba United Horticulture)*
P.O. Box 1047
1601 - 15th Street NW
Auburn, WA 98071-1047
Phone (253) 351-6432
E-mail mike.peterson@uap.com
4. Protime
Hobbs & Hopkins, Ltd.
1712 Southeast Ankeny
Portland, Oregon 97214
(*order by phone, by e-mail, or by web-site*)
Phone (503) 239-7518
web-site www.protimelawnseed.com
e-mail mark@protimelawnseed.com

9-14.3 FERTILIZER

9-14.3(1) GENERAL

Fertilizer shall be a standard commercial grade of organic or inorganic fertilizer of the kind and quality specified herein. It may be separate or in a mixture containing the percentage of total nitrogen, available phosphoric acid and water-soluble potash in the amounts specified. All fertilizers shall be furnished in standard unopened containers with weight, name of plant nutrients and manufacturer's guaranteed statement of analysis clearly marked, all in accordance with State and Federal law.

Acceptable commercial fertilizer shall be supplied in one of the following forms:

1. A dry free-flowing granular fertilizer suitable for application by agricultural fertilizer spreader,
2. A soluble fertilizer ground to a fineness that permits complete suspension of insoluble particles in water, suitable for application by power sprayer,
3. A granular or pelletized fertilizer, suitable for application by blower Equipment, or
4. A non-volatile liquid fertilizer.

Fertilizer provided for hydro-seeding applications, except for seed mix #4 biofiltration swale mix, shall be 10-10-10 construction grade (50% organic) plus micronutrients, applied at a rate that provides 1 pound of nitrogen per 1000 square feet. Secondary fertilizer applications shall be 3-1-2 construction grade (50% organic) plus micronutrients, applied at a rate to provide 2 pounds of nitrogen per 1000 square feet. Fertilizer for seed mix #4 (Section 9-14.2(5)) biofiltration swale mix shall have the nitrogen component containing 75% slow release methylene urea.

Fertilizer for woody plant material shall be 15-22-15 and shall meet the following analysis:

Total Nitrogen (N) 4.6% Ammoniacal Nitrogen 3.2% Urea Nitrogen 3.3% Coated Slow Release Urea Nitrogen 2.3% Slowly Available Water Soluble Nitrogen* 1.6% Water Insoluble Nitrogen	15%
Available Phosphoric Acid (P ₂ O ₅)	22%
Soluble Potash (K ₂ O)	15%
Sulfur (S)	4%
Boron (B)	0.06%
Copper (Cu)	0.06%
Iron (Fe)	1%
Manganese (Mn)	0.15%
Zinc (Zn)	0.14%

Derived from urea, sulfur-coated urea, methylene ureas, ammonium phosphate, sulfate of potash, muriate of potash, iron sulfate, calcium and sodium borate, copper oxide and sulfate, iron oxide sulfate and frit, manganese oxide and sulfate, zinc oxide and sulfate.

*Slowly available water soluble nitrogen from methylene ureas.

The Contractor shall provide a catalog cut of fertilizer and Manufacturer's Certificate of Compliance indicating all Specifications are met to the Engineer for approval.

9-14.3(2) LIME

Agricultural lime shall be of standard manufacture, flour grade, meeting the requirements of ASTM C 602.

9-14.4 MULCHES AND AMENDMENTS

9-14.4(1) STRAW MULCH

All straw mulch Material shall be in an air-dried condition free of noxious weeds and other materials detrimental to plant life. Straw shall be seasoned before baling or loading and shall be suitable for spreading with mulch blower Equipment.

9-14.4(2) WOOD CELLULOSE FIBER MULCH

Wood cellulose fiber mulch shall be specially processed 100 percent virgin wood fiber containing no growth or germination-inhibiting ingredients and shall be dyed a suitable color to facilitate inspection of placement of the Material. It shall be manufactured in such a manner that after addition and agitation in slurry tanks with water, the fibers in the Material become uniformly suspended to form a homogenous slurry. When hydraulically sprayed on the ground, the Material shall allow the absorption and percolation of moisture.

Each package of cellulose fiber shall be marked by the manufacturer to show the air dry weight content.

The hydro-seeding process shall utilize only 100% virgin wood fiber mulch in which 30% of the fibers shall be 0.15 inches long or longer and which shall have tackifier added to the mulch during the manufacturing process. Tackifier shall be added in accordance with Section 9-14.4(8). Mulch shall be applied at the following rates depending on the slope of the terrain:

1. 35 pounds per 1000 square feet, or 1500 pounds per acre, for areas having zero to 4H:1V slope.
2. 50 pounds per 1000 square feet, or 2000 pounds per acre, for areas having between 2H:1V and 4H:1V slope.
3. 60 pounds per 1000 square feet, or 2500 pounds per acre, for areas having a slope greater than 2H:1V.

Terrain that is steeper than 2H:1V, areas that exceed 10,000 square feet, and areas having a vertical drop greater than 15 feet shall be treated with a supplemental tackifier in accordance with Section 9-14.4(8).

9-14.4(3) BARK MULCH

Bark mulch shall consist of Douglas fir, pine, or hemlock bark. It shall be ground so that on a loose volume basis, a minimum of 95 percent passes a 1-1/2 inch sieve and no more than 55 percent passes a 1/4 inch sieve. The bark mulch shall not contain resin, tannin, or any other deleterious material that would be detrimental to plant life.

Wood chips salvaged from clearing and grubbing activity may be approved as a substitute for bark mulch, if found acceptable by the Engineer prior to application.

9-14.4(4) FERTILE MULCH AMENDMENT

Description:

- A. Fertile mulch shall be a mix of 1/3 composted biosolids and 2/3 composted organic material.
- B. Fertile mulch shall be free of weed seed, sticks, roots, trash, and other foreign material.

Quality Assurance:

- A. Biosolids shall be fully composted at an approved facility. *Approved* biosolid composting shall meet the requirements of the United States Environmental Protection Agency, Washington State Department of Ecology, and the state and local health departments.

- B. Compost shall consist of composted yard debris or organic waste material and shall consist of 100% recycled content. In addition, the organic material shall have the following physical characteristics:
1. Shall be screened using a sieve with openings no smaller than 5/16 inch and no greater than 7/16 inch.
 2. Shall pass a standard cress test for seed germination (90% germination compared to standard).
 3. Shall have a pH from 5.5 to 7.5.
 4. Shall have a maximum electrical conductivity of 3.0 ohms/cm.
 5. Shall have a maximum carbon to nitrogen ratio of 40:1.
 6. Shall be certified by the Process to Further Reduce Pathogens (PFRP) guidelines for hot composting as established by the United States Environmental Protection Agency.

Acceptable products or sources are:

1. "Steerco"
2. "Growco"
3. "Fertil-Mulch"
4. Sawdust Supply Company, Seattle, Wa.

9-14.4(5) DECOMPOSED ORGANIC MULCH AMENDMENT

Decomposed organic mulch, or composted organic Material, shall be comprised entirely of recycled organic Materials that have been sorted, ground, aerated and aged for a minimum of one year and of which 100% passes a 7/16 inch sieve. The mulch shall have a pH between 5.5 and 7.0 and shall have a carbon to nitrogen ratio between 20:1 and 40:1 with a maximum electrical conductivity of 3 ohms/cm. The product shall be tested by a Contractor provided accredited laboratory acceptable to the Engineer. The Contractor shall submit at least 2 Working Days in advance, a Manufacturer's Certificate of Compliance stating all test requirements meet the specified requirements. The product shall be certified free of all plant parasitic organisms, viable weed seeds, heavy metals or parasitic residues.

Decomposed organic mulch quantities for Projects requiring more than 35 cubic yards shall be tested before incorporation per Section 8-02.3(4) with testing procedure and correction of deficiencies as described in subitem C. of either Section 9-14.1(4)A or 9-14.1(4)B as applicable to the plants needs.

Decomposed organic mulch for Projects requiring 35 cubic yards or less (of the mulch) shall be delivered to the site with a soil fertility and micronutrient analysis from an approved independent laboratory. Amendments shall be incorporated at the Project Site per Section 8-02.3(4) to provide optimum conditions for plant establishment and early growth.

9-14.4(6) PEAT

The peat shall be derived from sphagnum and shall conform to ASTM D 2607 *unless otherwise specified in the Contract*. Peat shall be shredded and granulated to pass a 1/2 inch sieve and conditioned in storage piles for at least six months after excavation. The peat shall not contain substances harmful to plant life.

9-14.4(7) VERMICULITE / PERLITE / PUMICE

Vermiculite, perlite, or pumice shall be horticultural grade and free of any toxic materials.

9-14.4(8) TACKIFIER

Tackifier used to stabilize mulch shall provide a liquid soil bonding agent which gives immediate erosion protection and remains effective for a minimum of one full year on an undisturbed site.

Tackifier shall not be applied at temperatures below 50°F nor in wet or rainy weather. A minimum of 4 to 6 hours of curing time is required for acceptance of the application.

See Section 9-14.2(5) for condition where the addition of tackifier is required for biofiltration swale seed mix.

9-14.5 MATTING

9-14.5(1) JUTE MATTING

Jute matting shall be of a uniform open plain weave of unbleached, single jute yarn treated with a fire retardant chemical. The yarn shall be of a loosely twisted construction and shall not vary in thickness by more than 1/2 of its normal diameter. Jute matting shall be furnished in rolled strips approximately 50 yards in length. Matting width shall be 48 inches with an average weight of 0.92 pound per square yard. A tolerance of ±1 inch in width and ±5 percent in weight will be allowed.

Products such as "Erosion Control Fabric" (ECF) by Hydro-Turf, or "Soil Saver Textiles" by Ludlow which meet some, but not all, of the above Specifications may be substituted when allowed in the Contract.

9-14.5(2) EXCELSIOR MATTING

Excelsior matting shall be a machine produced mat of wood excelsior covered on one side with a biodegradable plastic netting or twisted paper composition. The Contractor shall submit to the Engineer for approval at least 10 Working Days in advance of proposed Material application, Manufacturer's Certificate of Compliance stating that the plastic Material(s) are environmentally safe and acceptable. This submittal shall be accompanied by a sample at least 3 square feet in area.

The excelsior matting shall have a minimum dry weight of wood fibers of 0.8 pound per square yard, plus or minus 5 percent. It shall be of uniform thickness, with the fiber evenly distributed over the entire area of the mat.

The width of a *single roll* of matting and net shall be a minimum 36 inches, and the *length of the* roll shall be approximately 150 feet.

9-14.5(3) CLEAR PLASTIC COVERING

Clear plastic covering shall meet the requirements of the NIST Voluntary Product Standard, PS 17-69, for polyethylene sheeting having a minimum thickness of 6 mil.

9-14.6 PLANT MATERIALS**9-14.6(1) DESCRIPTION**

Seedlings are plants grown from cuttings, seeds, or other approved propagation methods. Identifiable characteristics of the various species are considered to develop when they are approximately 3 years old and a minimum 24 inches in height.

Live cuttings are freshly cut stems taken from readily rooting species and selected from vigorous two to three-year-old branches. The acceptable range of lengths and diameters of the cuttings shall be as specified in the Contract. The stems shall have clean blunt cuts on the shoot end and diagonal cuts on the rooting end. Cuttings shall be taken from dormant plants and shall not be stored longer than one week except under conditions described in Section 9-14.6(7).

All measurements for plants will be per "each" (see Section 8-02.4). Height sizing typically is measured from the top of plant to where shoot meets root, typically at the soil line.

Whips are bareroot trees, generally unbranched, and are sized typically in 1-foot height increments ranging from 2 feet to 6 feet not including the root.

Broadleaf trees are branched, over 6 feet in height and are sized typically either by caliper or by height or by both caliper and height. Caliper is measured 8 inches above the soil line separating the root from the shoot.

Coniferous trees are over 2 feet in height and are sized typically in feet by height; however, the Bid Form may occasionally size coniferous trees by spread.

Shrubs and groundcovers begin to show form characteristic to their normal habit of growth and are sized in inches either by height or by spread or by height and spread.

Container sizes may be included in the plant description and sized typically by "inch diameter pot" container and "gallon" container.

9-14.6(2) QUALITY

With the exception of cuttings, all plant Material furnished by the Contractor shall conform to the requirements of the current issue of "American Standard for Nursery Stock" and in addition, shall comply with the following provisions:

1. All plant Material shall meet State and Federal requirements with respect to plant health and absence of diseases and insect infestation. *Inspection certificates required by law shall accompany each shipment of plant Material and shall be filed with the Engineer prior to planting.* All plant Material specified shall be first-class representatives of their normal species or varieties in healthy growing condition with normal well-developed branch system and vigorous root systems. They shall be free from disease and insect infestation, disfiguring knots, sun-scalds, abrasions of the bark, broken tops, torn roots and any other objectionable features. Large plants cut back to meet specified sizes will not be accepted. *All plants shall be nursery grown stock unless otherwise indicated in the Contract.* Trees shall be self-supporting, with straight trunks and with single straight leaders. Trees having damaged or missing leader, multiple leaders, or "Y" crotches will be rejected. The canopy shall be full.
2. Plants shall not have cuts over 3/4 inch diameter which are not satisfactorily callusing over. Leader shall be intact on each plant.
3. Plants furnished in pots or other containers shall be acclimated to outside conditions and equal to field grown stock.
4. Collected plant Material shall conform in quality, size, and grade to standards for nursery stock and shall be listed along with source location for approval at least 5 Working Days in advance of digging by the Supplier or Contractor.
5. Any plant Material that is to be replaced shall be of the same species, cultivar, and of equal size to the surviving plant Material.
6. Root balls of plant Materials shall be solidly held together by a fibrous root system and shall be composed only of the soil in which the plant has been actually growing. The ball shall be securely wrapped with non-treated jute burlap or other packing Material not injurious to the plant life. Root balls shall be free of weed or foreign plant growth.
7. Trees intended for installation as street trees shall have been grown with sufficient spacing to allow for symmetrical branch development which reflects the natural characteristics of the species. Trunks shall not be noticeably imperfect in vertical alignment, and there shall be no "included bark" in the crotches between the trunk and side branches.

Container grown plants shall be plants transplanted into a container and grown in that container sufficiently long for new fibrous roots to have developed so that the root mass retains its shape and holds together when removed from the container. Plant Material which is rootbound will be rejected.

Container sizes for plant Material of a larger grade than provided for in the container grown specifications of the American Standard for Nursery Stock (ASNS) shall be determined by the volume of the root ball specified in the ASNS for the same size plant Material.

All bare root plant Materials shall have a heavy fibrous root system. All plants shall be dormant at the time of planting.

Average height to spread proportions and branching shall be in accordance with the applicable sections, illustrations, and accompanying notes of the American Standard for Nursery Stock.

Plants, which have suffered damage as the result of girdling of the roots, stem, or a major branch; have deformities of the stem or major branches; have a lack of symmetry; have dead or defoliated tops or branches; or have any defect, injury, or condition which renders the plant unsuitable for its intended use, will be rejected.

9-14.6(3) HANDLING AND SHIPPING

All plant material shall be dug with care. The root system of all plant Material shall not be permitted to dry out at any time.

Evergreen and deciduous plant Materials shall be furnished balled and burlapped (B&B) unless otherwise specified in the Contract. Broken or "Made" balls will not be accepted. Balled and burlapped plants shall be handled by the ball of earth and not the plant. Unless otherwise specified in the Contract, plants may be supplied in suitable containers acceptable to the Engineer should the Contractor so desire. Container grown plants shall be well-developed to hold the earth intact after removal from the container without being root bound.

Balled and burlapped trees wrapped in treated or in synthetic material shall have all wrapping material removed from the tree at the time of planting. Balled and burlapped trees with wire or other material reinforcement of the burlap material shall have all wire or other reinforcement material removed at the time of planting. In all cases, the top 2/3 of the rootball as a minimum shall have all wrapping material of any kind removed before planting.

Handling and shipping shall be done in a manner that is not detrimental to the plants.

The nursery shall furnish a notice of shipment in triplicate at the time of shipment of each carload or other lot of plant Material. The original copy shall be mailed to the Engineer, the second copy to the consignee and the third copy shall accompany the shipment to be furnished to the Engineer at the Job Site. The notice shall contain the following information:

1. Name of shipper.
2. Date of shipment.
3. Name of commodity (including all names as specified in the Contract).
4. Consignee and delivery point.
5. Owner Contract number.
6. Point from which shipped.
7. Quantity contained.
8. Manufacturer's Certificate of Compliance of grade (statement that Material conforms to the Specifications).
9. Size (height, runner length, caliper, etc. as required).
10. Statement of root pruning (date pruned and size of pruning).
11. Signature of shipper by authorized representative.
12. Growing history of plant.

To acclimate plant Materials to Northwest conditions, all plant Materials used on a Project shall be grown continuously outdoors north of the 42nd Latitude (Oregon-California Border) from not later than April 1 of the year prior to the time of planting.

All container grown plants shall be handled by the container.

Plant Material shall be packed for shipment in accordance with prevailing practice for the type of plant being shipped, and shall be protected at all times against drying, sun, wind, heat, freezing, and similar detrimental conditions both during shipment and during related handling. Where necessary, plant Material shall be temporarily heeled in. When transported in closed vehicles, plants shall receive adequate ventilation. When transported in open vehicles, plants shall be protected by tarpaulins or other suitable cover Material.

9-14.6(4) TAGGING

Plants delivered shall have legible labels attached to each individual plant delivered as a separate unit or to each box, bundle, bale or container containing one or more plants. Labels shall give the necessary detailed information as to horticultural name, size, age, caliper or other data required to identify as conforming to Specifications. When the label is attached to a bundle, box, container, etc., containing more than one plant, information on the label shall show the quantity together with the other required information. Exception: All trees, whether furnished singly or bundled, shall be individually tagged with names, size or caliper, etc., needed as shown above. Contractor may refer to State of Washington Department of Agriculture, Orders 1229 and 1230, Nursery Stock Standards, regarding labeling of plant Material. Plant Material with illegible or missing tags will be rejected by the Engineer. All plants that are patented or trademarked shall have an individual tag on each plant. Plant Material tagged in the field (nursery) by the Landscape Architect shall be delivered with tags in place.

9-14.6(5) INSPECTION

The Contractor shall, as soon as practical, inform the Engineer as to the source of plant Materials for the Project (See Section 1-06.1). The Contractor shall notify the Engineer not less than 48 hours in advance of delivery of plants from the nursery to allow inspection at the nursery before delivery.

All trees will also be inspected by the Engineer at the Project Site prior to planting.

Root condition of plants furnished in containers shall be determined by removal of the plant from the container. Plants not meeting the requirements herein specified shall be immediately removed from the Project and replaced by the Contractor at the Contractor's sole expense.

Plant Material delivered, inspected and approved for planting shall be planted immediately. Plants not immediately planted by the Contractor may be temporarily stored after receiving approval from the Engineer (see Section 9-14.6(7)).

9-14.6(6) SUBSTITUTION OF PLANTS

No substitution of plant Material, species or variety, will be permitted unless evidence is submitted in writing to the Engineer that a specified plant cannot be obtained and has been unobtainable since the Award of the Contract. If substitution is permitted, it can be made only with written approval by the Engineer. The nearest variety, size, and grade as approved by the Engineer shall then be furnished.

9-14.6(7) TEMPORARY STORAGE

Plants stored under temporary conditions shall be the responsibility of the Contractor.

Plants stored in any location for use on the Project shall be protected at all times from extreme weather conditions by insulating the root balls with sawdust, soil, or other approved Material and by keeping the roots moist at all times.

Plant Material delivered and accepted shall be planted immediately. Plants that cannot be planted within 1 Day after arrival shall be "heeled-in" in accordance with accepted horticultural practice, as follows:

1. *Bare root plants shall be placed in trenches with roots covered with moist earth, sawdust or other acceptable Material and be kept moist. All bare root Material supplied in bundles shall have the bundle broken and the plants placed in the trenches separately.*
2. *Balled and burlapped plants shall have the root ball protected by earth, sawdust, or other material acceptable to the Engineer and the material shall be kept continuously moist.*
3. *Live cuttings may be stored for up to seven Days, provided they are protected against loss of moisture by a minimum six inch thick layer of earth, sawdust, or other acceptable material and be kept moist. Adequate ventilation with an ambient temperature maintained at or near 40 °F shall be provided above the cuttings to prevent fungus growth. Cuttings taken in November, December or January may be stored if wrapped to produce an airtight condition with temperature maintained between 33°F and 40°F.*

9-14.6(8) SOD

Description:

Sod shall be composed of the following:

Turf-type perennial rye grass	50%
Kentucky bluegrass	30% - 40%
Fine fescue	10% - 20%

Approved Varieties:

A. TURF-TYPE PERENNIAL RYE GRASS

Turf-type perennial rye grass shall consist of two or more of the following varieties:

Brightstar	Palmer II	Nighthawk	Prelude II	Saturn
SR 4200	Prizm	Affinity	Assure	SR 4100
Dimension	APM	Charger	Sherwood	Fiesta II
Blazer II	Stallion Sel	Tara	Commander	Birdie II

B. KENTUCKY BLUEGRASS

Kentucky bluegrass shall consist of two or more of the following varieties:

A-34	Cheri	Merit	Touchdown	Majestic
Adelphi	Columbia	Parade	Bristol	Sydsport
Baron	Fylking	Shasta	Bonnie Blue	-----

C. FINE FESCUE

Fine fescue shall consist of one or more of the following varieties:

Cindy	Janser	Salem	Flyer	Barskol
Shadow d/Endo	Southport	Ensylva	Barcrown	Promormer
Marker	Longfellow	Weekend	Tamara	-----

All sod shall comply with State and Federal law, including guaranty, with respect to inspection, plant diseases and insect infestation. Sod shipments shall have a certificate of origin and certification of approved treatment when shipment originates in known infected areas.

Sod shall be mature, densely rooted grass composed of equal amounts of two or more approved varieties of turf-type perennial rye grass and fine leafed fescues. Kentucky bluegrass may be included to provide stability for non-netted sod. Sod shall be free of weeds and reasonably free of objectionable grasses. *Plastic mesh is not allowed.* Sod shall be cut to a 1 inch mowing height prior to lifting from the field.

9-14.7 STAKES, GUYS, AND WRAPPING

Stakes shall be 8 foot long 2 inch diameter pressure-treated lodgepole pine wood stakes, with chamfered tops and 6 inch long conical points (see Standard Plan no. 100a). The Contractor shall be prepared to provide No. 5 deformed steel

reinforcing bar as a substitute stake for compatibility with tree grates as indicated on Standard Plan no. 100b. The stakes shall be installed as shown in the Standard Plans unless the Contract indicates otherwise.

Pre-manufactured adjustable ties shall be made of plastic Material such as No. 2 Chainlock or approved equal.

9-14.8 SHEAR BOARDS

Shear boards shall be 2 inch x 8 inch x 8 foot non-treated, rough finished lumber. When conditions require a length less than 8 feet, the Contractor shall plan the layout so that no individual length of cut shear board is less than 4 feet.

9-14.9 PAVER BLOCKS AND INTERLOCKING CONCRETE PAVERS

9-14.9(1) PAVER BLOCKS

Paver blocks shall be exposed aggregate concrete of the size indicated on the Drawings. Pavers shall be made from the following mix:

Material	Quantity per cubic yard
gray cement	564 pounds
5/8 inch minus gravel	2,400 pounds
building sand	1,030 pounds

A sample of exposed aggregate showing the desired amount of exposure is available at the Seattle Public Utilities' Materials Laboratory at 707 South Plummer Street.

The Contractor shall submit two sample paver blocks, which are representative of those to be used in the Project, for the Engineer's approval.

Exposed aggregate surface of all concrete paver units shall be sealed with a heavy-duty concrete enamel containing a 10% methylacrylate solution or approved equal. On request by the Engineer, the Contractor shall provide a 1 pint sample of sealant for testing. Sealant Material shall be approved by the Engineer prior to application.

9-14.9(2) INTERLOCKING CONCRETE PAVERS

Interlocking paver blocks shall be "Unistone" regular paver blocks manufactured by Westcon Construction Products Ltd., Olympia, Washington, or an approved equal.

The manufactured product shall meet the following Specifications in color, materials, physical properties configuration, and tolerances:

The color of the unit concrete paver shall be natural conforming to samples available from the Engineer. The nominal dimensions shall be:

length	9 inches
width	4-1/2 inches
thickness	2-3/8 inches

The length sides of the paver shall have two projections and two recessions per side. The projection on one side shall correspond to a recession on the opposite side. The projections and recessions shall be 3/8 inch when measured from the extension of the nominal width lines for the length of the paver.

The width sides of the paver shall have one projection and one recession per side. The projection on one side shall correspond to a recession on the other side. The projections and recessions shall be 3/8 inch when measured from the extension of the nominal length lines for the width of the paver.

The top and bottom surfaces shall be flat and parallel. The top side edge shall be chamfered 1/4 inch. The sides shall be perpendicular to the top and bottom surfaces. Full size edging pavers shall have one width side flat. Half size edging pavers shall be 1/2 the nominal length with one width side flat.

9-14.9(3) CEMENTITIOUS MATERIALS

Materials shall conform to the following:

Portland Cement	ASTM C 150
Blended Cement	ASTM C 595, Type 1S or 1P
Hydrated Lime	ASTM C 207, Type S
Pozzolan	ASTM C 618

9-14.9(4) AGGREGATES AND OTHER CONSTITUENTS

Aggregates shall conform to the following, except that grading requirements may not necessarily apply:

Normal weight ASTM C 33, for Concrete Aggregates.

Lightweight ASTM C 331, for Lightweight Aggregates for Concrete Masonry Units.

Air-entraining agents, color pigments, integral water repellents, finely ground silica, etc., shall be previously established as suitable by the Engineer for use in concrete, and shall conform to ASTM Standards where applicable, or shall be shown by test or experience not be detrimental to concrete.

9-14.9(5) PHYSICAL REQUIREMENTS

At the time of delivery to the Project Site, the average compressive strength of test samples shall not be less than 8000 psi with no individual paver unit less than 7200 psi.

The average absorption shall not be greater than 5%, with no individual unit greater than 7%.

The manufacturer shall satisfy the Owner by proven field performance of the laboratory freeze-thaw test that the paving units have adequate durability when subject to a freeze-thaw environment. See freeze thaw test in this Section.

Acceptable field performance is achieved when units similar in composition and produced by the same manufacturing process exhibit no objectionable deterioration for at least 3 years. The paver units used as the basis for proven field performance shall have been exposed to the same general type of environment, temperature, range, and Traffic volume.

When tested in accordance with Section 8 of ASTM C 67, specimens shall not have breakage or, greater than 1.0% loss on dry weight of any individual paver unit when subjected to 50 cycles of freezing and thawing. This test shall be conducted not more than 12 months prior to delivery of units. When tested in accordance with ASTM C 418. "Abrasion Resistance of Concrete By Sandblasting" specimens shall not have volume loss greater then 0.915 cubic inch per 7.75 square inch. The average thickness loss shall not exceed 1/8 inch.

9-14.9(6) PERMISSIBLE TOLERANCE IN DIMENSIONS

Length or width of paver unit shall not differ by more than 0.059 inches and heights shall not differ by more than 0.11 inches from the specified dimensions.

9-14.9(7) VISUAL INSPECTION

All paver units shall be sounded and free of defects that would interfere with the proper placing of unit; or impair the strength of the construction. Minor cracks or chips due to the usual method of manufacture and customary method of handling in shipment and delivery may be allowed subject to the discretion of the Engineer. *Paver units identified as unacceptable by the Engineer shall be replaced.*

9-14.9(8) SAMPLING AND TESTING

The Contractor shall submit three (3) samples of the paver unit to the SPU Material Laboratory for approval.

Sample units will be tested in accordance with ASTM C 140.

9-14.9(9) BASE COURSE

The Base Course shall be 6 inches in depth, shall conform to the requirements of Section 9-03.9(3) Crushed Surfacing, and shall consist of Mineral Aggregate Type 2, 1-1/4 inch minus crushed rock, as describe in Section 9-03. 20% "ISOLITE" CG2 shall be incorporated into the Base Course in paver areas extending the width of the sidewalk adjacent to tree pits (a 8' x 7" surface area per pit).

9-14.9(10) TOP COURSE OR KEYSTONE

The Top Course shall be 2 inch in depth and shall conform to the requirements of Section 9-03.9(3) Crushed Surfacing and shall consist of Mineral Aggregate Type 1, 5/8" inch minus crushed rock, as describe in Section 9-03. 20% "ISOLITE" CG2 shall be incorporated into the Base Course in paver in areas extending the width of the sidewalk adjacent to tree pits (an 8' x 7" surface area per pit).

9-14.9(11) LEVELING COURSE

The Leveling Course shall conform to the requirements of Section 9-03.11 Crushed Gravel, as modified herein.

The Material shall be 3/8 inch minus chip rock with the following gradation:

Sieve Size	% Passing
3/8 inch	98
1/4 inch	50 – 90
No. 4	25 – 55
No. 6	0 – 20
No. 10	0 – 10
No. 40	0 – 5
No. 200	0 – 3

No. 200 sieve size passing shall be brought to the job bagged and dry.

9-14.9(12) BEDDING SAND

The Bedding Sand shall conform to the requirements of Section 9-03.12(6) Washed Sand and Gravel and shall consist of Mineral Aggregate Type 6, washed sand, as described in Section 9-03.

9-14.9(13) JOINT FILLING SAND

The joint filling sand shall have the following grading:

Sieve Size	% Passing
US No. 8	95 - 100
US No. 16	60 - 70
US No. 30	15 - 25
US No. 50	0 - 5
US No. 100	0 - 2
US No. 200	0 - 1

The fracture shall be 100%. This Material is crushed sand, available from:

Manufacturers Mineral Company
1215 Monster Road Southwest
Renton, Washington 98055
425-228-2120

9-14.9(14) EDGING

Pre manufactured edging shall be Pave Edge, or Bric-edge manufactured by Oly'Ola Sales (1-800-EDGINGS) or approved equal.

9-14.10 TURF REINFORCEMENT

Turf reinforcement shall be Riter Ring Grass Grid Blocks or approved equal.

9-14.11 CEDAR EDGING

Material for edging shall be 2 inch x 4 inch cedar, construction grade or better with tight knots.

9-14.12 BOLLARDS

9-14.12(1) WOOD BOLLARDS

Bollards shall be nominal 8 inch x 8 inch, 90 Day stack dry, select Douglas Fir. Bollards shall be pressure-treated (by closed cylinder method) with Pentachlorophenol after cutting and predrilling. Tops and four sides of bollards shall be painted (above the notch) with 2 coats of white marine enamel as manufactured by Inter-Lux or approved equal applied per manufacturer's recommendations.

All metal parts (bolts, nuts, washers, etc.) shall be hot-dipped galvanized.

9-14.12(2) CONCRETE BOLLARDS

Concrete bollards shall be made of Class 5 (3/4) concrete (see Section 5-05), reinforced with four No. 4 deformed steel bars placed one inch clear below the concrete surface and held in place with No. 8 gauge wire ties. After forms are removed, concrete shall show a smooth dense face. Any surface irregularities showing above grade shall be scraped or stoned off; the surface shall then be washed and a 1:1 mortar shall be brushed on. After the initial set but before the final set, the excess mortar shall be rubbed off using burlap sacking or pieces of carpeting. The bollards shall then be cured by being kept damp with water for not less than 2 Days.

9-14.12(3) RESERVED

9-14.12(4) PADLOCKS FOR REMOVABLE BOLLARDS

The padlock shall be as manufactured by Best Lock Company, Lock number 2B672 with bronze body, 2 inch stainless steel shackle, and equipped with construction core or approved equal.

9-14.13 BENCHES

Benches shall be of the type indicated in the Contract.

9-14.14 TREE GRATES

Tree grates shall be manufactured in 2 equal sized sections made of gray iron conforming to ASTM A 536, GR80-56-06. Grates shall have a 3/4 inch nominal thickness and cover an area not less than 24 square feet. To accommodate tree growth, the grates shall have 3 or 4 centrally located concentric break-out rings allowing a 12 inch minimum to 30 inch maximum opening either in diameter. Break out rings shall have no more than 6 points of attachment per grate section and shall be scored to allow ease of expansion for tree growth. Grates shall be designed to not fail under a wheel load of up to 4000 pounds except at the break-out rings.

SECTION 9-15 IRRIGATION SYSTEM

9-15.1 PIPE AND FITTINGS

9-15.1(1) GENERAL

Pipe shall be galvanized iron, PVC, or polyethylene, as specified in the Contract.

9-15.1(2) GALVANIZED PIPE AND FITTINGS

Pipe shall be standard weight, hot-dipped galvanized iron or steel pipe, threaded and coupled. Pipe shall meet the requirements of ASTM A 120.

9-15.1(3) POLYVINYL CHLORIDE PIPE AND FITTINGS

PVC pipe upstream of the control valves shall be schedule 40 and conform to all requirements of ASTM D 1785.

PVC pipe downstream of the control valves shall be pressure rated for 200 psi and conform to all requirements of ASTM D 2241, SDR 21.

Fittings shall be of the solvent weld type except where risers, valves, etc., require threaded transition fittings. Fittings shall conform to the requirements of ASTM D 2466.

PVC pipe and fittings shall be non-toxic, free from taste and odor, and self-extinguishing.

Pipe shall be homogenous throughout and free of defects cracks, holes, foreign Materials, wrinkles, dents and blisters.

PVC pipe shall be continuously and permanently marked with the following information: manufacturer's name, kind of pipe, National Sanitation Foundation (NSF) approval and schedule number.

9-15.1(4) POLYETHYLENE PIPE

Polyethylene pipe shall be Class 80, SDR 15, medium density polyethylene pipe, meet the requirements of ASTM D 2239, conform to U.S. Commercial Standard CS-255, and be National Sanitation Foundation (NSF) approved.

9-15.2 CONTROL TUBING

Control tubing shall be copper refrigerator tubing meeting the current requirements of ASTM B 280 in the size specified on the Drawings. Tubing and fittings shall be capable of withstanding a 300 psi operating pressure, and shall be of the size indicated on the Drawings.

9-15.3 SLEEVE

Pipe sleeves shall be PVC schedule 40. Sizes and installation shall be in accordance with the Drawings and Standard Plan no. 128.

Conduit shall meet the requirements of Section 9-34.

9-15.4 IRRIGATION AUTOMATIC CONTROLLERS

Automatic controllers shall be installed in electrical controller cabinets on a concrete base as shown on Standard Plan no. 129. The dimensions and details of the controller cabinet shall be as shown on Standard Plan no. 129 unless otherwise dimensioned and detailed in the Contract. A manufacturer of acceptable irrigation controller cabinets is Skyline Electric and Manufacturing Co., Seattle, Washington.

The controller shall be an electrically timed device for automatically opening and closing control valves for predetermined periods of time and mounted so that all normal adjustments are conveniently located for use by the operator. Controllers shall be enclosed in a weatherproof metal enclosure. The Contractor shall submit a Shop Drawing of the padlock secured enclosure sized adequately to hold all specified equipment. The enclosure shall include a modified free-standing shelf measuring 12 inches x 12 inches x 15 inches high to hold the Controller, and one GFCI outlet with 15 amp circuit breaker (10,000 amp AIC) located in the upper right hand corner. All 120 volt wiring shall be behind a dead front panel. The controller shall be solid state and capable of operating the irrigation system as designed and constructed and shall include the following operating features:

1. Each controller station shall be adjustable for setting to remain open for any desired period of time - from five minutes or less to at least one hour.
2. Adjustments shall be provided whereby any number of Days may be omitted and whereby any one or more positions on the controller can be skipped. When adjustments are made, they shall continue automatically within a 14 Day cycle until the operator desires to make new adjustments.
3. Controls shall allow any position to be operated manually both on or off whenever desired.
4. Controls shall provide for resetting the start of the irrigation cycle at any time and advancing from one position to another.
5. Controllers shall contain an on-off switch and fuse assembly.
6. Controller adjustments shall be such that the open cycle may be doubled or repeated not less than 3 times during the complete watering cycle.
7. Controller shall have a power failure cutout.
8. Controller shall be UL approved and marked accordingly.

Contractor shall provide an outdoor rated padlock by Best Manufacturing Company with a removable blue core.

9-15.5 SPRINKLER HEADS

Sprinkler heads shall be of the type, pattern, and coverage shown on the Drawings at rated operating pressure specified, discharging not more than the amount of gallons per minute specified.

Sprinkler heads shall be designed so that spray adjustments can be made by either an adjustment screw or interchangeable nozzles. Watering cores shall be easily removed without removing the housing from the pipe.

All turn heads shall be designed with turf flanges having 2 gripping holes to facilitate removal of the head.

When the Contract does not specify irrigation system spacing, or does not specify irrigation head make or model, then the Contractor shall submit the missing information to the Engineer for approval at least 10 Working Days in advance of ordering Materials. Approval, and request for approval of substitution, of sprinkler heads will be based on compatibility of Materials with other Owner systems at the Project Site (see Section 1-02.4(1)). The Contractor shall design the layout of such systems incorporating efficient and adequate coverage without overspray.

9-15.6 ELECTRICAL WIRE

Wire from controller to valves shall be #14 UF direct burial (UL approved), red or black for the hot side, white for neutral (solid copper). The auxiliary wires, where required, shall be any third color (except green). UF and UL designations shall be clearly marked on the insulation jacket of all wires.

9-15.7 IRRIGATION VALVES**9-15.7(1) GATE VALVES**

Gate valves, when called for on the Drawings, shall be heavy duty bronze conforming to the requirements of ASTM B 62. Valves shall be of the same size as the pipes on which they are placed and shall have union or flange connections. Service rating (for non-shock cold water) shall be 300 psi. Valves shall be of the double disk, taper seat type, with rising stem, union bonnet and handwheel. Manufacturer's name, type of valve and size shall be cast on the valve.

9-15.7(2) CONTROL VALVES**9-15.7(2)A MANUAL CONTROL VALVES**

Manual valves shall be bronze or brass, angle type with hex brass union. Service rating shall be not less than 150 psi nonshock cold water. Valves shall be designed for underground installation with suitable cross wheel for operation with a standard key. The Contractor shall furnish three suitable operating keys per Contract. Valves shall have removable bonnet and stem assembly with adjustable packing gland and shall house long acme threaded stem to ensure full opening and closing. Valve discs shall be full floating with replaceable seat washers.

9-15.7(2)B AUTOMATIC CONTROL VALVES

Automatic remote control valves shall be globe pattern with flanged or screwed connections as required. The valve shall be constructed so as to allow all internal parts to be removable from the top of the valve without disturbing the valve installation. Screwed valves shall be provided with union connections.

Valves shall be of a "normally closed" design and shall be electric solenoid operated, having maximum rating of 6.5 watts utilizing 24 volts AC power. Solenoids shall be directly attached to the valve bonnets or body with all control parts and ports completely internal. Valves shall be of 150 psi brass or bronze, or iron body bronze-mounted combination. The time interval for valve closing operation shall be a minimum of 5 seconds for complete closure at constant rate of closing and a minimum of 3 seconds to completely open at a constant rate of opening. A manual control bleed cock shall be included on the valve to operate the valve without electric current. A manual shutoff stem with cross handle for wrench operation is required for manual adjustment from fully closed to wide open. Once the manual adjustment is set, the valve can be operated automatically in the adjusted position. Water flow shall be completely stopped when the control valve is closed either manually or automatically. Automatic control valves and automatic controllers need not be of the same manufacturer.

All automatic control valves shall be pressure reducing valves unless otherwise specified in the Contract.

9-15.7(2)C AUTOMATIC CONTROL VALVES WITH PRESSURE REGULATOR

The automatic control valve with pressure regulator shall be similar to the automatic control valve and shall also reduce the inlet pressure to a constant lower pressure regardless of supply fluctuations. The regulator shall be fully adjustable.

9-15.7(3) QUICK COUPLER VALVES

Quick coupler valves shall have a service rating not less than 125 psi for nonshock cold water. The body of the valves shall be of cast leaded semi-red brass alloy No. C84400 conforming to ASTM B 584. The base of the valve shall have standard female pipe threads. The design of the valve shall be such that it opens only upon inserting a coupler key and closes as the coupler is removed from the valve. Leakage of water between the coupler and valve body when in operation will not be accepted. The valve body receiving the coupler shall be designed with double worm slots to allow smooth action in opening and closing of the valve with a minimum of effort. Slots shall be notched at the base to hold the coupler firmly in the open position. Couplers shall be of the same material as the valve body with stainless steel double guide lugs to fit the worm slots. Couplers shall be of one piece construction with steel reinforced side handles attached. All couplers shall have standard male pipe threads at the top. Couplers shall be furnished with all quick coupler valves unless otherwise specified in Contract. See Standard Plan no. 121.

9-15.7(4) DRAIN VALVES

The Contractor shall install a 3/4 inch male automatic ball check drain valve at the low point in the system. The drain valve shall be drained to a pocket containing a minimum of 1/2 cubic yard of Mineral Aggregate Type 4. See Standard Plan no. 122.

9-15.7(5) CHECK VALVES

Check valves shall be heavy duty bronze or steel. The valves shall function by means of a hinged disc suspended from the body and able to close of its own weight. Valves shall be of the size as the pipes on which they are placed, unless otherwise specified in the Contract, and shall have union or flanged connections. Service rating (for non-shock cold water) shall be 300 psi. Manufacturer's name, type of valve and size shall be cast on the valve.

9-15.7(6) PRESSURE REDUCING VALVES

Pressure reducing valves shall have a minimum of 150 psi working pressure with an adjustable outlet range of 20 to 70 psi. The valves shall be factory set as shown on the Drawings.

Pressure reducing valves shall be rated for safe operation at 175 psi nonshock cold water.

9-15.7(7) **THREE WAY VALVES**

Three way valves shall be tight closing, three port, ball or plug type, constructed to permit straight through and 90 degree flow only. The valve shall be of bronze or approved corrosion resistant body Materials and shall have a minimum of 150 psi working pressure. The head of the valve, or handle when applicable, shall be permanently marked to indicate port position. Whenever handles are included as an integral part of the valve, the Contractor shall remove the handles and give them to the Engineer for ultimate distribution to the Maintenance Division.

9-15.7(8) **FLOW CONTROL VALVES**

Valve body materials shall be plastic or metal. Internal parts shall be stainless steel. Valves shall be factory set to design flows. Valves shall have no external adjustment and be tamper proof when installed. One-quarter inch and smaller flow control valves shall have a minimum pressure absorption range of 2 to 32 psi. One and one half inch and larger flow control valves shall have a minimum pressure absorption range of 3 to 50 psi.

Flow shall be controlled to 5 percent of design volumes.

9-15.7(9) **AIR RELIEF VALVE**

The air relief valve shall automatically relieve air and break a vacuum in the serviced pipe. Body Materials shall be installed exactly at all high points.

9-15.8 **VALVE BOXES**

All automatic control valves, flow control valves, and pressure reducing valves shall be provided with valve boxes. Valve boxes shall be sized as appropriate to allow efficient access to components and shall be approved by the Engineer prior to installation. Valve boxes shall be extendable to obtain the depth required. Where 1 inch diameter Schedule 80 PVC braces are required for quick coupler valves as indicated on Standard Plan no. 121, the box shall have holes adequately sized to securely snug fit the brace. All manual drain valves and manual control valves shall be equipped with a protective sleeve and cap as shown in the Standard Plans.

9-15.9 **BACKFLOW PREVENTION DEVICES**

Backflow prevention devices shall be as specified in Section 9-30.16.

9-15.10 **HOSE BIBS**

Hose bibs shall be constructed of bronze or brass, angle type threaded to accommodate a 3/4 inch hose connection, and shall be key operated. Design shall be such as to prevent operation by wrench or pliers.

9-15.11 **DETECTABLE MARKING TAPE**

Detectable marking tape shall consist of inert polyethylene plastic that is impervious to all known alkalis, acids, chemical reagents, and solvents likely to be encountered in the soil, with a metallic foil core to provide the most positive detection and pipeline locators.

The tape shall be color coded and shall be imprinted continuously over its entire length in permanent black ink. The message shall convey the type of line buried below and shall also have the word "Caution" prominently shown. Color coding of the tape shall be as follows:

Utility	Tape Color
Water	Blue
Sewer	Green
Electrical	Red
Gas-Oil	Yellow
Telephone-CATV	Orange

The width of the tape shall be as recommended by the manufacture for the depth of installation.

SECTION 9-16 **FENCE AND GUARDRAIL**

9-16.1 **CHAIN LINK FENCE AND GATES**

9-16.1(1) **GENERAL**

All Material used in the construction of chain link fence and gates shall be new. Iron or steel Material shall be galvanized; however, exceptions to galvanizing are listed in various Standard Plans and other Standard Specifications. Imperfectly galvanized Material or Material upon which serious abrasions of galvanizing occur will not be acceptable.

The base Material for the manufacture of steel pipes used for posts, braces, top rails, and gate frames shall conform to the requirements of ASTM F 1083. The base Material for the manufacture of steel H columns shall meet the requirements of ASTM A 663 or ASTM A 675.

Roll-formed posts, braces, and rails shall be made from sheet steel and shall conform with the details as shown on the Drawings or Standard Plan no. 450b. The Material for end, corner, and pull posts shall have a minimum yield strength of 35,000 psi. The minimum yield strength for Alternate A roll-formed line posts shall be 40,000 psi and for Alternate B

roll-formed line posts 45,000 psi. Top rail and braces to be used with Alternate A or B line posts shall conform to the minimum yield strength as required for either post respectively.

All posts, braces, top rails, and gate frames shall be hot-dip galvanized. They shall have a minimum average of 1.8 ounces zinc coating per square foot of surface area with no individual test being below 1.6 ounces zinc coating per square foot of surface area. In the case of members made from pipe, this area is defined as the total area inside and outside. A sample for computing the average weight of coating is defined as a 12 inch piece cut from each end of the galvanized member. Fittings shall be galvanized in accordance with the requirements of ASTM F 626. Other Materials shall be galvanized in accordance with the requirements of ASTM A 153.

9-16.1(2) POSTS

All posts for chain link fence shall be of the shape, size, and weight per foot shown on Standard Plan no. 450b. Roll-formed end, corner, and pull posts shall be made from 0.1345 inch minimum thickness sheet steel and shall have integral fastening loops to connect to the fabric for the full length of each post. Roll-formed line posts shall be made from 0.110 inch minimum thickness sheet steel for Type 3 and Type 4 fences and shall be made from 0.120 inch minimum thickness sheet steel for Type 1 and Type 6 fences.

An acceptance tolerance for posts for chain link fence allows for deviation from the weight per linear foot specified in the Standard Plans. This tolerance shall be applied on an individual post basis and shall be plus or minus 5 percent for tubular and H-section posts and plus or minus 6 percent for roll form sections. Materials that exceed the weight per foot or wall thickness Specification may be accepted, providing they do not interfere with the proper construction of the fence.

9-16.1(3) TOP RAIL, BRACES, AND TRUSSES

Top rail and compression braces shall be of the type and size shown on Standard Plan no. 450b. Tension truss rods shall be 3/8 inch round galvanized rods with drop forged turnbuckles, or other approved type of adjustment. Couplings for tubular sections shall be outside sleeve type and at least 6 inches long. Roll-formed top and brace rails shall be made from 0.0747 inch thick sheet steel and shall be an open rectangular section with internal flanges. The acceptable thickness tolerance for sheet steel members shall be ± 0.006 inch.

9-16.1(4) TENSION WIRE AND ATTACHMENTS

Top and bottom wire shall be 7 gage coil spring steel wire of good commercial quality and shall have a zinc coating averaging 0.8 ounce per square foot of surface area. All tension wire attachments shall be hot-dip galvanized steel. Eye bolts shall be 3/8 inch diameter and of sufficient length to fasten to the type of posts used.

9-16.1(5) RESERVED

9-16.1(6) FITTINGS

All fittings and miscellaneous hardware shall be malleable cast iron or pressed steel. Fittings shall be galvanized in accordance with ASTM F 626. Galvanizing of miscellaneous hardware not covered by ASTM F 626 shall be in conformance with ASTM A 153. Fittings for any particular fence shall be those furnished by the manufacturer of the fence.

9-16.1(7) CHAIN LINK FENCE FABRIC

Chain link fabric shall consist of 11 gage wire (0.120 inch diameter) for Types 3, 4, and 6 fence; and 9 gage wire (0.148 inch diameter) for Type 1 fence. The fabric wire may be one of the following Materials provided that only one type shall be selected for use in any one Contract:

1. Galvanized steel wire conforming to ASTM A 392.
2. Galvanizing shall be Class I performed by the hot-dip process.
3. Aluminum coated steel wire conforming to ASTM A 491.
4. Class II aluminum wire conforming to 6061-T94 alloy.

The wire shall be woven into approximately 2 inch diamond mesh. The width and top and bottom finish of the fabric shall be as shown in Standard Plan nos. 450a and 450c.

9-16.1(8) FABRIC BANDS AND STRETCHER BARS

Fabric bands shall be 1/8 inch by 1 inch nominal and stretcher bars 3/16 inch by 3/4 inch nominal. Nominal shall be construed to be the area of the cross-section of the shape obtained by multiplying the specified width by thickness. A variation of plus or minus 5 percent from this theoretical area shall be construed as "nominal" size. Both shall be hot-dip galvanized to meet the requirements of ASTM F 626.

9-16.1(9) TIE WIRE

Tie wire shall be 9 gage aluminum wire complying with the ASTM B 211 or 9 gage galvanized wire meeting the requirements of AASHTO M 279. Galvanizing shall be Class 1. Hog rings shall meet the requirements of AASHTO M 279. Galvanizing shall be Class 1.

9-16.1(10) CHAIN LINK GATES

Gate frames shall be constructed of not less than 1-1/2 inch inside diameter hot-dip galvanized pipe with nominal weight of 2.72 pounds per linear foot. The corners of the gate frame shall be fastened together and reinforced with a malleable iron or pressed steel fitting designed for the purpose, or they may be welded. Welding shall conform to the requirements of Section 6-03.3(25). All welds shall be ground smooth and painted with a high zinc dust content paint meeting the requirements of MIL-P-21035. The paint shall be applied in one or more coats to provide a dry film thickness of 3.5 mils minimum.

Cross trussing shall be 3/8 inch galvanized steel adjustable rods.

Chain link gate fence fabric Material shall be the same as used for the chain link fence (see Section 9-16.1(7)).

Each gate shall be furnished complete with necessary hinges, latch, and drop bar locking device designed for the type of gate posts and gate used on the Project. Gates shall have positive type latching devices with provisions for padlocking.

Gate frames constructed of steel sections, other than pipe, that are fabricated in such a manner as to form a gate of equal or better rigidity may be used provided they are approved by the Engineer.

9-16.1(11) MISCELLANEOUS

All concrete shall be Class B as specified in Section 6-02.3.

9-16.2 WIRE FENCE AND GATES

9-16.2(1) GENERAL

All materials used in the construction of the wire fence shall be new. All iron or steel material shall be galvanized. Imperfectly galvanized material or material upon which serious abrasions of galvanizing occur shall not be used.

9-16.2(2) STEEL FENCE POSTS AND BRACES

All posts for chain link fence shall be of the shape, size, and weight per foot shown in Standard Plan no. 450b. Roll-formed end, corner, and pull posts shall be made from 0.1345 inch minimum thickness sheet steel and shall have integral fastening loops to connect to the fabric for the full length of each post. Roll-formed line posts shall be made from 0.110 inch minimum thickness sheet steel for Type 3 and Type 4 fences and shall be made from 0.120 inch minimum thickness sheet steel for Type 1 and Type 6 fences.

Line posts may be channel, T, U, Y, or other approved shape, manufactured solely for use as fence posts. One type of line post shall be used throughout the Project. Line posts shall be studded, slotted, or properly adapted for attaching either wire or mesh in a manner that does not damage the galvanizing of posts, wire, or mesh during the fastening. Line posts shall have a minimum weight of 1.33 pounds per linear foot and shall be provided with a tapered steel anchor plate attached securely having a minimum weight of 0.67 pounds and having a surface area of 20 square inches \pm 2 square inches.

End, corner, gate, and pull posts shall meet the requirements specified for line posts, except that the posts shall have a minimum weight of 3.1 pounds per linear foot and anchor plates and special studs, slots, or adapters for the attachment of wires will not be required.

Braces shall have a minimum weight of 3.1 pounds per linear foot.

All posts, braces, anchor plates, and hardware not covered by ASTM F 626 shall be galvanized in accordance with the requirements of ASTM A 123, or ASTM A 153.

A tolerance of minus 5 percent on the weight of individual posts, braces, or anchor plates will be permitted.

9-16.2(3) WOOD FENCE POSTS AND BRACES

Douglas fir, Western red cedar, hemlock, or larch shall be used in the construction of wood fence posts and braces. The material shall be of good quality and approved by the Engineer before use. Peeler cores shall not be used for round posts. Wood fencing materials shall have sufficient sapwood in the outer periphery to obtain the specified penetration of preservative. Fencing materials shall be cut to the correct length before pressure treatment.

Line posts shall be 3 inch minimum diameter round posts or nominal 3 inch by 3 inch square sawed posts. If the posts are to be pointed for driving, they shall be pointed before treatment. Line posts shall be at least 7 feet in length.

Pull posts and brace posts shall be 6 inch diameter round posts or nominal 6 inch by 6 inch Material not less than 7 feet in length.

End, gate, and corner posts, and posts at an intersecting fence shall be 6 inch diameter round posts or nominal 6 inch by 6 inch material not less than 7 feet 10 inches in length.

All sawed posts and timbers shall meet the requirements of Section 9-09.2.

The preservatives used to pressure-treat wood fencing materials shall meet the requirements of Section 9-09.3.

The retention and penetration of the preservative shall be as follows:

Minimum Retention in Pounds Per Cubic Foot		
Preservative	Sawed Posts	Round Posts
Creosote	10.00	8.00
Pentachlorophenol	0.50	0.40
ACA	0.40	0.40
ACZA	0.40	0.40
ACQ	0.40	0.40

Minimum Penetration	
for material 5 inch or less	0.40 inches penetration and 90% of sapwood
for material 5 inch or greater	0.50 inches penetration and 90% of sapwood

9-16.2(4) BRACE WIRE

Brace wire shall be 9 gage galvanized wire meeting the requirements of ASTM A 116, galvanizing Class 3.

9-16.2(5) STAPLES AND WIRE CLAMPS

The staples used to attach the wire fencing to wood posts shall be galvanized 9 gage, 1-1/2 inches long meeting the requirements of AASHTO M 279, galvanizing Class 1.

The wire clamps used to attach the wire fencing to steel posts shall be galvanized 11 gage wire meeting the requirements of AASHTO M 279, galvanizing Class 1.

9-16.2(6) BARBED WIRE

Barbed wire shall conform to the requirements of AASHTO M 280, and shall consist of two strands of 12-1/2 gage wire, twisted with four point 14 gage barbs with the barbs spaced an average of 5 inches apart. Galvanizing shall be Class 3.

9-16.2(7) WIRE MESH

Wire mesh shall conform to the requirements of AASHTO M 279, and shall consist of seven horizontal wires with vertical stays spaced 6 inches apart. The top and bottom wires shall be 10 gage, and the intermediate wires and vertical stays shall be 12-1/2 gage. The mesh shall have a total width of 26 inches (Design No. 726-6-12-1/2). Galvanizing shall be Class 3. The zinc-coated wire as represented by the test specimens shall be capable of being wrapped in a close helix at a rate not exceeding 15 turns/minute around a cylindrical steel mandrel having a diameter the same as the specimen being tested, without cracking or flaking the zinc coating to such an extent that any zinc can be removed by rubbing with the bare fingers.

9-16.2(8) VERTICAL CINCH STAYS

Vertical cinch stays shall be 9-1/2 gage galvanized wire meeting the requirements of AASHTO M 279, except that the minimum weight of zinc coating shall be 0.3 ounce per square foot of uncoated wire surface.

9-16.2(9) WIRE GATES

Gate frames shall be constructed of galvanized standard weight pipe with a nominal diameter of not less than 1 inch. The pipe shall conform to the requirements of ASTM A 53. Wire gates shall be not less than 48 inches in height and shall be designed to fit openings of the widths called for in the *Contract*. Each gate shall be provided with two upright braces of the same material as the frame, spaced at 1/3 points in the gate. All gates shall be provided with adjustable 3/8 inch diameter diagonal truss rods from corner to corner.

The gate frame shall be provided with wire mesh conforming to the requirements specified in Section 9-16.2(7), except that it shall consist of 10 horizontal wires and have a total width of 47 inches (Design No. 1047-6-12-1/2).

Each gate shall be furnished complete with necessary hinges and latch designed for use with the type of gate posts used on the Project. The hinges shall be so designed as to be securely attached to the gate post and to enable the gate to be swung back against the fence.

Double gates shall be hinged in the same manner as single gates and shall be provided with an approved drop bar locking device.

9-16.2(10) MISCELLANEOUS

Bolts, nuts, and hinges used in the construction of fence and gates shall be galvanized in accordance with AASHTO M 232.

All concrete shall be Class B in accordance with Section 6-02.3.

9-16.3 NON-WEATHERING STEEL BEAM GUARDRAIL**9-16.3(1) RAIL ELEMENT**

The W-beam or thrie beam rail elements, backup plates, reducer sections, and end sections shall conform to "A Guide to Standardized Highway Barrier Hardware" published by AASHTO, AGC, and ARTBA. All rail elements shall be formed from 12-gage steel except for thrie beam used for bridge rail retrofit and Design F end sections, that shall be formed from 10 gage steel.

The rail splices shall have a minimum total ultimate strength of 80,000 pounds at each joint.

The 6 inch channel rails and splice plates shall conform to ASTM A 36. All fabrication shall be complete before galvanizing.

The holes in the plate shall be slotted to facilitate erection and to permit expansion and contraction. The edges of the rail shall be rolled or rounded so they present no sharp edges. Where the rail is on a curve, the plates at the splice shall make contact throughout the area of splice. When the radius of curvature is less than 150 feet, the rail shall be shaped in the shop.

9-16.3(2) POSTS AND BLOCKS

Posts and blocks may be of creosote treated timber, pentachlorophenol treated timber, waterborne ammoniacal copper arsenate (ACA), ammoniacal copper zinc arsenate (ACZA), treated timber or galvanized steel; except only treated timber posts and blocks may be used for weathering steel beam guardrail. Blocks made from alternate Materials that meet NCHRP Report 350 criteria may be used in accordance with the manufacturer's recommendations. Except for terminal or anchor assemblies, all posts for any one Project shall be of the same type (wood or steel). Posts and blocks shall be of the size and length shown in WSDOT Standard Plan nos. C-1 and C-1a and meet the requirements of these Specifications. Post and block may be S4S or rough sawn.

Timber posts and blocks shall conform to the grade specified in Section 9-09.2, except pine lumber No. 1 grade may be used for the blocks. *Timber posts and blocks shall be fabricated as specified in the WSDOT Standard Plans before being treated.* Timber posts and blocks shall be treated by the empty cell process to provide a minimum retention, depending on the treatment used, according to the following:

Creosote oil	12 lbs. pcf. of lumber
Pentachlorophenol	0.60 lbs. pcf. of lumber
ACA	0.50 lbs. pcf. of lumber
ACZA	0.50 lbs. pcf. of lumber
ACQ	0.50 lbs. pcf. of lumber

Treatment shall be in accordance with Section 9-09.3.

Steel posts, blocks, and base plates, where used, shall conform to ASTM A 36, and shall be galvanized in accordance with AASHTO M 111. Welding shall conform to Section 6-03.3(25). All fabrication shall be completed prior to galvanizing.

9-16.3(3) GALVANIZING

Beam rail elements and terminal sections shall be galvanized in accordance with AASHTO M 180, Class A, Type 2, except that the rail shall be galvanized after fabrication, with fabrication to include forming, cutting, shearing, punching, drilling, bending, welding, and riveting. In addition, the minimum average weight of zinc coating shall be 2 ounces per square foot of surface (not sheet), the average to be determined on the basis of three individual tests, no one of which may be less than 1.8 ounces per square foot of surface (not sheet). The aluminum content of the zinc bath during actual galvanizing operations shall not exceed 0.01 percent. Channel rails, splice plates, WF steel posts, and base plates shall be galvanized in accordance with ASTM A 123. Anchor cables shall be galvanized in accordance with Federal Specification RR-W-410, Table II, galvanized at finished size. Bolts, nuts, washers, plates, rods, and other hardware shall be galvanized in accordance with ASTM A 153.

9-16.3(4) HARDWARE

Bolts, unless otherwise specified in other Standard Specifications or in the Standard Plans, shall comply with ASTM A 307, Grade A specifications. High strength bolts shall conform to the requirements of AASHTO M 164. Nuts shall comply with ASTM A 563, Grade A specifications. Washers, unless otherwise specified in other Standard Specifications or in the Standard Plans, shall meet ASTM F 844 specifications. The Contractor shall submit a Manufacturer's Certificate of Compliance for the bolts, nuts, and washers prior to installing any of the hardware.

9-16.3(5) ANCHORS

Welding shall conform to Section 6-03.3(25).

All welding shall be at least equal in strength to the parent metal.

All fabrication shall be complete and ready for assembly before galvanizing. No punching, drilling, cutting, or welding will be permitted after galvanizing unless authorized by the Engineer.

Foundation tubes shall be fabricated from steel conforming to the requirements of ASTM A 500, Grade B, or ASTM A 501.

The anchor plate assembly shall develop a minimum tensile strength of 40,000 pounds.

The anchor plate, W200 x 27 and metal plates shall be fabricated of steel conforming to the specifications of ASTM A 36.

Anchor cable shall be ¾-inch preformed, 6 x 19 wire strand core or independent wire rope core (IWRC), galvanized, right regular lay manufactured of improved plow steel with a minimum breaking strength of 42,800 pounds. Two certified copies of mill test reports of the cable used shall be furnished to the Engineer.

Swaged cable fittings shall develop 100 percent of the specified breaking strength of the cable. One swaged fitting attached to 3 feet of cable shall be furnished to the Engineer for testing.

The swaged fitting and stud assembly shall be of steel conforming to the requirements of American Iron and Steel Institute C-1035 and shall be annealed and galvanized suitable for cold swaging.

Welded wire fabric for Type 1 anchor shall conform to ASTM A 185.

All metal components of the anchor and cable assembly and not less than the top 14 inches of the W8 x 17 for the Type 2 anchor shall be hot-dip galvanized in accordance with Section 9-16.3(3).

Cement concrete, of the class specified, shall conform to the applicable requirements of Section 6-02.3.

Cement grout shall consist of one part Portland cement and two parts sand.

9-16.3(6) INSPECTION AND ACCEPTANCE

The Contractor shall give at least 3 Working Days advance notice to the Engineer before the rail elements are fabricated in order that inspections may be provided. The Contractor shall arrange for all facilities necessary for the inspection of material and workmanship at the point of fabrication of the rail element, and Inspectors shall be allowed free access to necessary parts of the premises.

The Inspector shall have the authority to reject materials or workmanship which do not fulfill the requirements of these Specifications. In cases of dispute, the Contractor may appeal to the Engineer, whose decision will be final.

The Inspector may accept a mill test report certifying that the steel used in fabricating the rail element meets the requirements of the Specifications. The Owner reserves the right, however, to require the Contractor to furnish samples of the steel proposed for use and to determine to its satisfaction that the steel meets the Specification requirements. Steel rail elements, fittings, terminal section hardware, and bolts may be accepted by the Engineer based on the Manufacturer's Certification of Compliance.

9-16.4 WIRE MESH SLOPE PROTECTION

9-16.4(1) GENERAL

All metal material used in the construction of wire mesh slope protection shall be new and galvanized. Imperfectly galvanized material or material upon which serious abrasion of galvanizing occurs will not be acceptable.

9-16.4(2) WIRE MESH

The galvanized wire mesh shall consist of No. 9 gage (0.148 inch diameter) commercial quality zinc coated steel wire, 3-1/2 inches x 5-1/2 inches diamond mesh chain link conforming to the requirements of AASHTO M 181. Galvanizing shall conform to the requirements of ASTM A 392 except the weight of zinc coating shall be 0.80 ounce per square foot minimum, of uncoated wire surface. Galvanizing shall be done before weaving.

The wire mesh fabric shall have knuckled selvages.

Alternate wire mesh for slope protection shall be double twisted mesh. The mesh shall be of nonraveling construction and consist of a uniform double twisted hexagonal mesh of hot-dip galvanized steel wire having a diameter of 0.120 inch after galvanization. The wire shall be galvanized prior to weaving into the mesh and shall conform to ASTM A 641, Class 3, Finish 5, Soft temper. The minimum tensile strength shall be 60,000 psi when tested in accordance with ASTM A 370. Openings shall be hexagonal in shape and uniform in size measuring not more than 3-1/4 inches by 4 1/2 inches, approximately 9 square inches. Lacing wire shall be the same specifications as the wire used in the wire mesh except that its diameter shall be 0.0866 inch after galvanization.

Edges shall be mechanically selvaged in such a manner as to prevent unraveling, and shall develop the full strength of the mesh. The wire used for the selvege shall have a nominal diameter of 0.1535 inch.

9-16.4(3) WIRE ROPE

Wire rope shall be 5/8 inch diameter zinc coated steel structural wire rope conforming to the requirements of ASTM A 603, Class A.

9-16.4(4) HARDWARE

All rings shall be drop-forged steel, heat treated after forging. Lightweight wire rope thimbles weighing approximately 13.8 pounds per hundred shall be used with the 1/2-inch diameter wire rope. Wire rope clips may be drop-forged steel or cast steel for use with 1/2-inch wire rope. All rings, thimbles, wire rope clips, and U-bolts shall be galvanized in accordance with AASHTO M 232, Class C, except castings shall be Class A, and forgings shall be Class B.

9-16.4(5) HOG RINGS AND TIE WIRE

Hog ring fasteners and tie wire shall be manufactured of 9 gauge steel wire meeting federal specification QQ-W-461 (AISI numbers 1010 and 1015) finish 5; medium hardness and tensile strength; Class 3 coating.

9-16.4(6) GROUT

When required, grout for anchors shall consist of one part Portland cement and three parts of clean sand. The Portland cement shall conform to the requirements of Section 9-01.2(1).

9-16.4(7) ANCHOR RODS

Anchor rods shall be of good quality steel. The eye may be drop forged or formed with a full penetration weld and shall develop 100 percent of the rod strength. The anchor rod shall be galvanized in accordance with ASTM A 153.

9-16.5 RESERVED

9-16.6 GLARE SCREEN

9-16.6(1) GENERAL

All material used in the construction of the fence shall be new. Iron or steel material shall be galvanized or aluminum coated as specified. Imperfectly galvanized or aluminum coated material, or material upon which serious abrasions of galvanizing or aluminum coating occur, will not be acceptable.

9-16.6(2) GLARE SCREEN FABRIC

Glare screen fabric shall consist of diamond woven wire mesh. The fabric wire may be 0.148 inch diameter aluminum alloy complying with the Aluminum Association requirements for alloy 6061T94, or it may be 0.148 inch diameter (9 gage) iron or steel wire which shall meet all of the requirements of ASTM A 392 galvanized or A 491 for aluminum coated, except that galvanizing of Type 2 glare screen fabric shall be not less than 0.8 ounce per square foot and shall be done before weaving. Aluminum coating shall be Class II.

Type 1 glare screen mesh size shall be approximately a 1 inch diamond. Type 2 glare screen mesh size shall be a maximum of 3-1/2 inch vertical and 5-1/2 inch horizontal. The design shall permit the slats to be installed in a vertical position as shown in *WSDOT Standard Plans* without distortion of the slats.

9-16.6(3) POSTS

Line posts for Type 1 glare screen shall be 1.5 inches by 1.875 inches hot-dip galvanized steel H column with a minimum weight of 2.8 pounds per linear foot. Line posts for Type 2 glare screen shall be 1.95 inches by 2.25 inches hot-dip galvanized steel H column with a minimum weight of 4.0 pounds per linear foot, or 2 inch inside diameter hot-dip galvanized steel pipe with a nominal weight of 3.65 pounds per linear foot provided only one type shall be used on any one Project.

End, corner, brace, and pull posts shall be 2 inch inside diameter hot-dip galvanized steel pipe with nominal weight of 3.65 pounds per linear foot. Intermediate pull posts (braced line posts) shall be H column as specified for line posts. Brace post sleeves shall be 2-1/2 inch inside diameter hot-dip galvanized steel pipe with nominal weight of 5.79 pounds per linear foot.

The base material for the manufacture of steel pipes used for posts shall conform to the requirements of ASTM A 53, except the weight tolerance on tubular posts shall be applied as follows. The base material for the manufacture of steel H columns shall meet the requirements of ASTM A 675.

Posts provided for glare screen will have an acceptance tolerance on the weight per linear foot, as specified, equal to plus or minus 5 percent for tubular and H-section posts. This tolerance applies to each individual post.

All posts, braces, and top rails shall be hot-dip galvanized. They shall have a minimum average of 1.8 ounces zinc coating per square foot of surface area with no individual test being below 1.6 ounces zinc coating per square foot of surface area. In the case of members made from pipe, this area is defined as the total area inside and outside. A sample for computing the average of weight of coating is defined as a 12 inch piece cut from each end of the galvanized member.

9-16.6(4) TENSION WIRE

Top and bottom tension wire shall be 7 gage coil spring steel wire of good commercial quality and shall have a zinc coating averaging 0.8 ounces per square foot of surface area.

9-16.6(5) CABLE

The tension cable shall be 1/4 inch diameter aluminum coated or hot-dip galvanized, 7 wire strand steel cable conforming to the requirements of ASTM A 474 for aluminum coated or ASTM A 475 for galvanized, High-Strength Grade. Galvanizing shall be Class A.

9-16.6(6) CABLE AND TENSION WIRE ATTACHMENTS

All tension wire and cable attachments shall be hot-dip galvanized steel conforming to the requirements of AASHTO M 232 unless otherwise specified in the Contract. Eye bolts shall have either a shoulder or a back-up nut on the eye end and be provided with an eye nut where needed or standard hex nut and lock washer and be 5/8 inch diameter for tension cable and 3/8 inch diameter for tension wire and of sufficient length to fasten to the type of posts used. Where the eye bolt is to be installed through a pipe section, two lead washers and one steel washer shall also be provided. Turnbuckles shall be of the shackle end type, 1/2 inch diameter, with standard takeup of 6 inches and provided with 3/8 inch diameter pins. Thimbles shall be light weight wire rope thimbles for use with 1/4 inch diameter cable. Wire rope clips shall have a U-bolt diameter of 5/16 inch for use with 1/4 inch diameter cable. Anchor shackles shall be 3/8 inch diameter with a minimum distance between eyes of 1-1/16 inch and a pin diameter of 7/16 inch. Seizing shall be 0.032 inch diameter galvanized annealed iron wire.

9-16.6(7) SLATS**9-16.6(7)A WOOD SLATS**

Wood slats shall be 3/8 inch by 2-3/8 inch by the height designation of the fence. Material shall be finished and treated cedar or redwood and shall be free from loose knots, cracks, and other imperfections. A dimensional tolerance of $\pm 1/16$ inch in width or thickness is allowed provided that the maximum space between slats does not exceed 3/4 inch.

9-16.6(7)B PLASTIC SLATS

Plastic slats shall be 3/8 inch by 2-3/8 inch by the height designation of the fence. They shall be manufactured from tubular polyethylene color pigmented material consisting of high density virgin polyethylene and color pigments, designed to retard ultraviolet penetration. The material shall have a minimum wall thickness of 0.0030 inch \pm 0.0003 inch and shall remain flexible without distortion and without becoming brittle through a temperature range of -70°F to + 250°F. Tensile strength shall be at least 3600 psi and the melt index shall not exceed 0.25.

Plastic slats shall be retained in place by means of U-shaped retainer members at the bottom and top of the fence. Retainer members shall be of the same material as the slats.

The color for plastic slats will be approved by the Engineer from samples submitted by the Contractor.

9-16.6(8) FITTINGS

Fittings shall be malleable cast iron or pressed steel and galvanized in accordance with the requirements of AASHTO M 232.

Fittings for any particular fence shall be those furnished by the manufacturer of the fence.

9-16.6(9) FABRIC BANDS AND STRETCHER BARS

Fabric bands shall be 1/8 inch by 1 inch nominal and stretcher bars 3/16 inch by 3/4 inch nominal. Nominal shall be construed to be the area of the cross-section of the shape obtained by multiplying the specified width by thickness. A variation of minus 5 percent from this theoretical area shall be construed as "nominal" size. Both shall be hot-dip galvanized to meet the requirements of ASTM F 626.

9-16.6(10) TIE WIRE

Tie wire shall be 9 gage aluminum wire complying with the ASTM B 211 for alloy 1100 H14 or 9 gage galvanized wire meeting the requirements of AASHTO M 279. Galvanizing shall be Class 1.

9-16.7 RESERVED**9-16.8 WEATHERING STEEL BEAM GUARDRAIL****9-16.8(1) RAIL AND HARDWARE**

Steel for rail elements and terminal sections shall conform to ASTM A 606 or ASTM A 607. Bolts, nuts, and washers for installation of the weathering steel shall be manufactured from steel conforming to ASTM A 242M and shall not be galvanized. If required, 6 inch channels and fittings shall conform to ASTM A 242. In addition, all steel for the guardrail components shall conform to one of the following chemical compositions, percent (ladle):

Composition

	C	Mn	P	S	Si	Cu	Cr	Ni	Zr
No. 1	0.12 Max.	0.20 to 0.50	0.07 to 0.15	0.05 Max.	0.25 to 0.75	0.25 to 0.55	0.30 to 1.25	0.65 Max.	-----
No. 2	0.12 Max.	0.50 to 1.00	0.12 Max.	0.05 Max.	0.20 to 0.90	0.50 Max.	0.40 to 1.00	1.00 Max.	0.10 Max.

Blast cleaning or pickling to remove mill scale will not be required. All fabricated steel parts shall be handled with care to avoid gouges, scratches, and dents. The steel shall be kept clean of all foreign material, such as paint, grease, oil, chalk marks, crayon marks, concrete spatter, or other deleterious substances. Natural oxidation of the steel will not be considered foreign material. Storage in transit, in open cars and trucks, for an extended period will not be permitted. Steel parts stored outside in yards or at Job Sites shall be positioned to allow free drainage and air circulation.

9-16.8(2) ANCHORS

Guardrail anchors may either be furnished as provided in Section 9-16.3(5) or they may be nongalvanized and fabricated from steel conforming to ASTM A 242 with the exception that all Type 1 anchors shall have galvanized cable and fittings as specified in Section 9-16.3(5).

9-16.8(3) POSTS AND BLOCKS

Posts and blocks for weathering steel beam guardrail shall comply with the requirements of Section 9-16.3(2).

SECTION 9-17 FLEXIBLE GUIDE POSTS**9-17.1 GENERAL**

See Section 8-10 for flexible delineator posts.

Flexible guide posts shall be made of a flexible, nonwarping, nonmetallic, durable plastic material; shall be resistant to damage due to impact, ultraviolet light, ozone, hydrocarbons, and other effects of atmospheric weathering; shall resist stiffening with age; and shall be designed for a minimum life equaling 60 months of outdoor service.

The post system shall be designed for permanent installation to resist overturning, twisting, and displacement from wind and impact forces.

Each flexible guide post shall be permanently identified with the manufacturer's name, the month and year of fabrication and a mark indicating the recommended burial depth. The letters shall be solvent resistant, a minimum of 1/4 inch in height, and permanently affixed to the post unless otherwise specified *in the Contract*, the color of the guide post shall be white or brown as indicated on the Drawings. Guide post length shall be in accordance with Section 8-10.3.

The reflective panel on a flat or elliptical guide post shall have a minimum width of 3 inches facing *Traffic*. The reflective sheeting shall have a minimum area of 24 square inches (3 inches by 8 inches). The reflective panel on a round guide post shall have a 9 inch minimum band of reflective sheeting visible for 360 degrees.

9-17.2 LABORATORY TESTS

Ten guide posts of each model shall be conditioned in an oven for two hours at 120°F ± 3°F. After conditioning, the guide post shall be bent backwards at 90 degrees from the vertical to simulate a field impact. The guide post shall, without cracking, recover to within 10 degrees of its original position within five minutes. Color shall remain unchanged. Any appreciable change in color, cracking on more than one face, or not returning to within 10 degrees of vertical, is considered a failure. At least 70 percent of the posts must pass to be considered for preapproval.

The same ten guide posts tested for heat resistance shall be tested for cold resistance. The guide posts shall be conditioned for 24 hours at -20°F, ± 3°F, then subjected to the same testing as for heat resistance. The guide posts shall conform to the same cracking, color, and recovery standards as for heat resistance. At least 70 percent of the posts must pass to be considered for preapproval.

Three guide posts of each model shall be subjected to deflection testing. The guide posts shall be fixed near the base in such a way that 4 feet of the post is cantilevered. The guide posts shall then be loaded 1/2 inch from the free end until collapse is observed. (Collapse is defined as the point at which the guide post can no longer resist any further loading.) The stress at collapse shall be calculated as follows:

$$P = K(Q/b)$$

Where:

- P is the equivalent stress in pounds per square foot.
- Q is the load at collapse in pounds.
- b is the post width (diameter of major axis) in inches.
- K is constant equal to 6 inches per square foot.

The value of P shall be no less than 3.43 pounds per square foot for round guide posts and 5.30 pounds per square foot for flat or elliptical guide posts. Any load below these values or cracking of more than one face, of any of the guide posts is considered a failure.

The three guide posts subjected to deflection testing shall be subjected to cyclic loading with an amplitude of 2 inches at the tip, with a cycle testing machine. Each guide post shall be cycled 30,000 times at 60 cycles per minute. When the cyclic tests are completed, the three guide posts shall again be subjected to deflection testing. The average load of the posts after cyclic loading shall be a minimum of 80 percent of the average load of the posts tested before cyclic loading. A value below this limit is considered a failure.

Three guide posts of each model shall be subjected to a 5.5-pound deflection test. The guide posts shall be fixed near the base in such a way that 4 feet of the post is cantilevered. The guide post shall then be loaded 1/2 inch from the free end with a 5.5-pound weight. A deflection greater than 29 inches is considered a failure.

A 9 inch specimen from the unreflectorized portion of each of three guide posts shall be prepared. The specimens shall be cycled at 1000 hours in a weatherometer in accordance with ASTM G 53 (3 hr. 60C UV, 3 hr. 50C CON). The specimens shall show no signs of delamination, distress, or discoloration. Physical properties of tensile strength and rigidity shall be maintained within 80 percent of the unconditioned values.

9-17.3 FIELD TESTS

Ten guide posts of each model, supplied in accordance with Section 9-17.4, shall be installed by the manufacturer's representative at the SPU Materials Laboratory designated test site. Anchoring Materials shall be driven such that the anchor is flush with, or below, the ground level. The test temperature shall be at or below 50°F.

The ten guide posts shall be struck seven times at 35 mph, then two times at 55 mph, by a car or equivalent hood and bumper device with an 18 inch height. After each impact, the delineators shall be inspected for the following criteria:

1. A minimum of 50 percent of the reflective sheeting shall be retained undamaged. An area of damage greater than 50 percent is considered a failure.
2. If the guide post leans more than 10 degrees from vertical it is considered a failure.
3. Any cracking, other than surface cracking evident on only one face of the post, is considered a failure.
4. Pullout in excess of 3 inches is considered a failure.

If an individual guide post fails any one of the above criteria in the 35 mph series of impacts, the product is unacceptable. At least 70 percent of the guide posts must pass each criteria in the 55 mph series of impacts to be acceptable.

9-17.4 APPROVAL

The Contractor shall submit a Manufacturer's Certificate of Compliance stating all materials meet or exceed Contract requirements.

SECTION 9-18 PRECAST TRAFFIC CURB AND BLOCK TRAFFIC CURB

9-18.1 PRECAST TRAFFIC CURB

9-18.1(1) AGGREGATES AND PROPORTIONING

The cement, fine and coarse aggregate, and reinforcing steel to be used in the manufacture of precast concrete traffic curb shall meet the following requirements and be submitted to the SPU Materials Laboratory for approval:

1. Aggregates shall conform to the requirements of Section 9-03 except that they shall be uniformly graded up to a maximum size of 3/8 inch and shall contain sufficient fine fractions to permit securing the type of surface finish specified herein. The aggregate shall be approved by the SPU Materials Laboratory before it is used.
2. Reinforcing steel shall conform to the requirements of Section 9-07.
3. *The cement concrete mix shall be composed of not less than 1 part Portland cement to approximately 2 parts of fine concrete aggregate and 3-1/4 parts of coarse concrete aggregate adjusted to secure proper workability. The Contractor will be allowed to use a different concrete mix if approved by the Engineer, provided that it develops not less than 4,000 psi compressive strength when tested at the age of 28 Days.*

9-18.1(2) MIXING

The mixers shall be kept in good repair and shall be equipped with an automatic timing device, and a positive device for regulating the quantity of water added to each batch. The latter device must be approved by the Engineer before use.

After all Materials, including water, have been placed in the mixer, the Materials shall be mixed for a period of not less than 1-3/4 minutes, or as long as necessary to produce a uniform concrete mix. No water shall be added to any batch after completion of the mixing period. Each batch of concrete shall be completely emptied from the mixer before placing more Materials in it. A batch which has not been placed within 30 minutes from the time water was first added shall not be used.

The amount of water in the concrete shall be kept to a minimum, consistent with the manufacture of a dense mix, free from air bubbles and surface defects in excess of the tolerance limits specified.

9-18.1(3) FORMS

Forms for precast traffic curbs shall be steel or special concrete mold. The use of forms or molds made of plaster of paris, wood, or other absorptive Material will not be permitted.

Bulkheads shall be tight fitting so that there is no leakage of mortar between the bulkhead and form.

The Materials and methods used for lubricating the forms shall be such that they do not result in discoloration of the curb at any time. A minimum quantity of lubricant shall be used and all excess lubricant shall be removed.

9-18.1(4) PLACING CONCRETE

The concrete shall be consolidated by external vibration, or by other means if approved by the Engineer, to produce a dense concrete throughout, having a minimum of air bubbles and honeycombing.

Reinforcing steel shall be placed and maintained in its proper position as shown in the Standard Plans.

Curb or buttons shall not be manufactured in an atmospheric temperature of less than 50°F.

9-18.1(5) REMOVAL OF FORMS

The curb shall be removed from the molds or forms with instructions, or by some other identified method, acceptable to the Engineer.

The loosening of the curb from the molds shall be carefully performed to avoid excessive shock and straining of the curb. When, in the opinion of the Engineer, undue shock is required to remove the curb from the molds, the stripping operation shall be deferred until such time as the curb may be removed without breakage.

9-18.1(6) CURING CONCRETE

Immediately after the concrete has been placed and consolidated in the mold, each unit shall be placed in a curing room fitted with water sprays and maintained at a relative humidity of not less than 90 percent and a temperature of not less than 60°F, nor more than 100°F. Each unit shall remain in the curing room for a period of not less than 10 Days, except that if Type III cement is used, the period in the curing room may be reduced to 5 Days.

9-18.1(7) FINISH

The curb shall have a smooth, glassy finish on all exposed surfaces.

Excess honeycombing in the back of the curb may be cause for rejection of the curb. Honeycombing areas in the back of the curb which, in the opinion of the Engineer, are not detrimental to the curb need not be patched. The workmanship of the bottom finish shall be such that no mechanical interlocking of the mortar bed and the curb bottom or anchor groove occurs.

9-18.1(8) SURFACE TREATMENT

As soon as the units have been taken out of the curing room and thoroughly surface dried to a depth of at least 1/4 inch, two coats of a water-repellent compound, meeting the requirements of Section 9-18.4, shall be brush applied. When the first coat has dried, the second coat of water-repellent compound shall be applied.

9-18.1(9) DIMENSIONS AND SHAPE

The curb shall conform to the dimensions and shape shown on the Drawings within a tolerance of 1/4 inch in length and 1/8 inch in alignment.

9-18.1(10) CURB LENGTHS

Curb shall be made in pieces not less than 3 feet nor more than 6 feet in length, except when A-block or C-block curbs are specified. Circular curbing shall be made only for such radii as called for in the details on the Drawings.

9-18.1(11) DEFECTIVE CURB

Not more than 2 percent of the top area in any one piece of curb shall be defective, and not more than 5 percent of the total length of the top corners of reflecting faces in any one piece of curb shall be broken or rounded. There shall be not more than 30 air holes in any linear foot of curb nor more than 50 in any 3 linear feet of curb. All curb having defects in excess of any of the above will be rejected immediately upon inspection after removal from the forms. However, failure to reject the curb at that time will not ensure its final acceptance. 90 percent of the curb laid shall not have more than 10 percent of the maximum allowable number of defects specified above.

An air hole shall be defined as any hole 1/8 inch or larger in diameter or depth.

All defects within the limits permitted, apparent upon removal of forms, shall be repaired immediately.

The sum of the length of the lines of discoloration caused by a cracked mold in any one piece of curb shall not exceed 50 percent of the length of the curb, and the maximum length of any single line of discoloration shall not exceed 18 inches. 75 percent of the curb laid shall be entirely free from lines of discoloration. The employment of heat to obliterate lines of discoloration will not be permitted. The process used to obliterate lines of discoloration shall be subject to the approval of the Engineer.

The repairing of molds which are chipped or broken shall be done in a manner that the broken or chipped areas are not apparent on the curb made in those molds.

All curb in which surface checking develops during the first five Days after manufacture will be rejected.

Hidden air holes at or immediately below the exposed surface of the curb which are in excess of the limits specified and are disclosed by testing the surface by means of a rubber hammer, will be cause for rejection of the curb.

All curb in which cracking is in evidence immediately after removal from the molds will be rejected. A crack is defined as any continuous separation of the concrete greater than 3 inches in length.

All curb which varies in dimensions, alignment, or surface contour in excess of the tolerance specified will be rejected.

9-18.1(12) REPAIRING CURB

Curb having defects which are not sufficient cause for its rejection shall be neatly repaired immediately after removal from the molds in a manner subject to the approval of the Engineer. However, no patching or other repairs shall be made without the permission of the Engineer. *Patches shall be undercut if, in the opinion of the Engineer, this operation is necessary to achieve an acceptable patch.*

All holes larger than 1/16 inch diameter in the exposed surface of acceptable curb or buttons shall be filled with cement mortar.

9-18.1(13) IDENTIFICATION MARKING

The date of manufacture, the length, and identification number corresponding to the detail layout shall be marked in black paint on the back or end of each piece of curb.

Rejected curb shall be marked on the back or end surfaces in a practical and semi-permanent manner to identify each cause of rejection.

9-18.1(14) SHIPPING

No unit of curb shall be shipped from the manufacturing plant prior to 21 Days after manufacture, except that if Type III cement has been used, the units may be shipped 14 Days after manufacture.

9-18.1(15) SAMPLING AND INSPECTION

The Contractor shall submit, for the approval of the Engineer, an advance sample of curb which shall be at least equivalent in color, surface texture, and bottom finish to the standard as set forth in these Specifications. No repairing of any kind shall be done on the advance sample. Upon approval, the advance sample shall be stored at the plant or site of manufacture in a location readily accessible to the Inspector where there is adequate daylight for examination. The advance sample shall be protected from damage and discoloration and shall be used as a standard of comparison for color, surface texture, and bottom finish for all curb manufactured. All curb furnished shall be equivalent in the foregoing respects.

The inspection at the plant will be made just prior to shipment, at which time examination will be made of the alignment, contour, color, cracks, surface damage or discoloration, broken corners or edges, and any other defects which may have developed, and to check the Laboratory test reports for strength. However, intermediate inspections may be made to determine surface checking and hidden air holes if it is impractical to examine for these defects at the final inspection.

9-18.2 RESERVED

9-18.3 BLOCK TRAFFIC CURB

In construction of the block traffic curb, the Contractor shall have the option of using either length block shown in Standard Plan no. 414, provided the same length block is used throughout the entire Project.

The curb units shall be made from Portland cement and high quality sand and gravel, the proportions of which shall be left to the discretion of the producer as long as the unit develops a minimum compressive strength of 1,600 psi at 28 Days when tested for end loading.

The proportions of sand, gravel, and cement, the type of forms used, and the method of compacting the concrete in the forms shall all be such that as dense, smooth, and uniform a surface as is practicable for a concrete masonry unit is obtained on the finished curb units. The faces that are to be exposed shall be free from chips, air holes, honeycomb, or other imperfections, and cracks shall be tight, with the following exceptions: not more than 5 percent of each curb unit contains cracks, contains small chips which are not larger than 1/4 inch in any dimension, and air holes which are not larger than 1/4 inch in diameter or depth. The units used in any contiguous line of curb shall have approximately the same color and surface characteristics.

9-18.4 WATER-REPELLENT COMPOUND

The water-repellent compound shall be a clear, penetrating type, silicone resin base compound containing no filler or other Material which leaves a film on the surface of the masonry after it is applied, and bonds securely to the masonry. It shall be of such consistency that it can be applied readily by brush or spray to the masonry at atmospheric temperature down to minus 20°F.

The average absorption of three test specimens treated with the water-repellent compound, when tested in accordance with the methods used in the Laboratory shall not exceed 2 percent after being partially immersed in water for 72 hours immediately after curing.

The average moisture vapor transpiration (breathing) of three test specimens, when tested in accordance with the methods used in the Laboratory, shall be not less than 50 percent at seven Days.

The water-repellent compound shall be approved by the Laboratory before it is used.

9-18.5 SODIUM METASILICATE

Sodium metasilicate shall comply with ASTM D 537.

SECTION 9-19 PRESTRESSED CONCRETE GIRDERS**9-19.1 CONCRETE AGGREGATES AND PROPORTIONING**

The concrete for prestressed girders shall have the minimum compressive strengths as specified on the Drawings. Aggregates used in the mix shall conform to the following:

1. Coarse aggregate shall be in accordance with Section 9-03.1(3),
2. Fine aggregate shall be in accordance with Section 9-03.1(2), Class I or Class II.
3. The manufacturer may revise the grading of the coarse aggregate provided that the concrete mix design is qualified with the modified gradation.

The Contractor shall submit for review a proposed mix design for each design strength. Included shall be evidence acceptable to the Engineer that the proposed mix design meets design requirements. *The mix design review will not preclude any requirements for the concrete placed in the girders.*

The concrete mix shall be prepared and placed in accordance with the appropriate sections of Section 6-02.

Water used in mixing the concrete shall conform to the requirements of Section 9-25.1.

Cement shall conform to the requirements of Section 9-01.

Chemical admixtures shall conform to the provisions of Section 9-23.7.

The total chloride ion (C1-) content shall be as specified in Section 6-02.3(2)A.

9-19.2 REINFORCEMENT

Reinforcement shall meet the requirements of Section 9-07 and shall be placed in accordance with the requirements of Section 6-02.3(24).

SECTION 9-20 RESERVED**SECTION 9-21 PLASTIC TRAFFIC BUTTONS AND LANE MARKERS****9-21.1 PLASTIC TRAFFIC BUTTON AND LANE MARKER TYPE 1****9-21.1(1) GENERAL**

Plastic Traffic Button and Lane Marker Type 1 shall be composed of thermosetting resins, pigments and inert ingredients and shall be of uniform composition throughout. The color shall be yellow or white to correspond to the delineation line color.

9-21.1(2) PHYSICAL AND CHEMICAL PROPERTIES

The traffic buttons and lane markers shall be of uniform composition and free from surface irregularities, cracks, checks, chipping, peeling, spalling, crazing, and other physical defects impairing their appearance, application, or durability.

The molding process shall be such that coarse aggregate particles on the curved surface are covered by not less than 1/16 inch of pigmented Material.

The and lane marker Type 1 shall meet the following requirements (see Standard Plan no. 700):

Lane Marker/Traffic Button (Description)	Lane Marker Type 1
Diameter	3-7/8 inch to 4-1/8 inch
Weight (pounds)	0.275 min.
State Reflectance	80% min.
Impact Resistance (Inch-pounds)	15 min.
Planeness of Base:	
Concavity (Inches)	0.02 max.
Convexity (Inches)	0.05 max.
Titanium Dioxide (% by weight)	21 min.
Resin Content (% by weight)	20 min.

9-21.1(3) TEST METHODS

Test methods shall be as follows:

1. **Reflectance:** Reflectance will be measured with a photovolt Reflectance Meter or its equivalent by comparing the buttons to a 75 percent brightness standard.
2. **Impact Resistance:** Impact resistance will be measured by allowing a 1 pound steel ball to fall 15 inches (free fall) onto the lane marker, supported by but not bonded to a steel base plate.
3. **Titanium Dioxide Content:** The titanium dioxide content will be determined by ashing representative portions of the lane marker, treating the ash with a boiling (NH₄)₂SO₄•H₂SO₄ solution, filtering, and

measuring the absorbance of the filtrate at about 410 millimicrons. Calibration shall be with known samples using ASTM D 921.

4. **Resin Content:** Resin content will be determined by ashing and igniting representative portions of the marker.

Additional information on the test methods is available from the Seattle Public Utilities' Materials Laboratory.

9-21.2 LANE MARKERS TYPE 2A AND TYPE 2B

The markers shall consist of an acrylic plastic shell filled with a tightly adhering potting compound. The shell shall contain prismatic reflective faces as shown in Standard Plan no. 700 to reflect incident light from opposite directions.

9-21.2(1) PHYSICAL PROPERTIES

The shell shall be molded of methyl methacrylate or acrylonitrile butadiene styrene (ABS).

Filler shall be a potting compound selected for strength, resilience, and adhesion adequate to pass physical requirements as outlined herein.

The outer surface of the shell shall be smooth except for purposes of identification and shall contain methyl methacrylate reflective faces in the color specified. As an option, thin untempered glass may be bonded to the prismatic reflective faces to provide an abrasion resistant surface.

The base of the marker shall be substantially free from gloss or substances that may reduce its bond to adhesive. This shall be done by embedding sand or inert granules on the surface of the potting compound prior to its curing.

The markers shall be fabricated as follows:

Lane Marker (Description)	Lane Marker Type 2A	Lane Marker Type 2B
Dimensions of Plastic Shells	4 inch x 4 inch x 0.65 inch or octagonal w/4 inch across flats	4.7 inch x 2.3 inch x 0.52 inch
Slope of Reflecting Face	20 deg. to 30 deg.	20 deg. to 30 deg.
Area of Each Reflecting Surface	3.0 to 3.25 square inches	1.87 square inches

9-21.2(2) OPTICAL REQUIREMENTS

1. **Definitions:**

Horizontal entrance angle shall mean the angle in the horizontal plane between the direction of incident light and the normal to the leading edge of the marker.

Observation angle shall mean the angle at the reflector between observer's line of sight and direction of the light incident on the reflector.

Specific intensity (S.I.) shall mean candlepower of the returned light at the chosen observation and entrance angles for each foot-candle of illumination at the reflector on a plane perpendicular to the incident light.

2. **Optical Requirements:** The specific intensity of each crystal reflecting surface at 0.2 degrees observation angle shall be not less than the following when the incident light is parallel to the base of the marker:

Hor. Ent. Angle	S.I.
0 degrees	3.0
20 degrees	1.2

Yellow reflectors shall be not less than 60 percent and red reflectors not less than 25 percent of the above values.

3. **Optical Testing Procedure:** A random lot of markers will be tested. The markers to be tested shall be located with the center of the reflecting face at a distance of 5 feet from a uniformly bright light source having an effective diameter of 0.2 inch.

The photocell width shall be 0.05 inch. It shall be shielded to eliminate stray light. The distance from light source center to the photocell center shall be 0.21 inch. If a test distance of other than 5 feet is used, the source and receiver dimensions and the distance between source and receiver shall be modified in the same proportion as the test distance.

Failure of more than 4 percent of the samples shall be cause for rejection of the lot.

9-21.2(3) STRENGTH REQUIREMENTS

Markers shall support a load of 2,000 pounds as applied in the following manner:

1. A marker shall be centered over the open end of a vertically positioned hollow metal cylinder. The cylinder shall be 1 inch high with an internal diameter of 3 inches and wall thickness of 1/4 inch. The load shall be slowly applied to the top of the marker through a 1 inch diameter by 1 inch high metal plug centered on the top of the marker.
2. Failure occurs with either a breakage or significant deformation of the marker at any load of less than 2,000 pounds.

SECTION 9-22 MONUMENT FRAMES AND COVERS**9-22.1 GENERAL**

Monument castings shall conform to the requirements of ASTM A 48, Class 30 and shall be free of porosity, shrink cavities, cold shuts or cracks, or any surface defects which would impair serviceability. Repair of defects by welding, or by the use of "smooth-on" or similar Material, will not be permitted. The manufacturer shall certify that the product conforms to the requirements of these Specifications.

A bituminous coating meeting the requirements of Section 9-05 shall be applied to all faces.

Monument castings shall be machine finished or ground on seating surfaces to assure non-rocking fit in any position, and interchangeability. The foundry shall make standard frames and covers available to the Engineer to test fit and seating.

SECTION 9-23 CONCRETE CURING MATERIALS, ADMIXTURES, AND FLY ASH**9-23.1 SHEET MATERIALS FOR CURING CONCRETE**

Sheet Materials for curing concrete shall meet the requirements of AASHTO M 171, Sheet Materials for Curing Concrete, except that only white reflective type shall be used.

9-23.2 LIQUID MEMBRANE-FORMING CONCRETE CURING COMPOUNDS

Liquid membrane-forming compounds for curing concrete shall conform to the requirements of AASHTO M 148 (ASTM C 309) Type 1D or Type 2, Class A or Class B, except that the moisture loss when tested in accordance with WSDOT Test Method 814 shall be 2.50 grams maximum for all applications

Each lot of liquid membrane-forming curing compound shall be sampled at the Project Site and tested for acceptance. Liquid membrane-forming curing compound shall not be used in the absence of acceptable test results.

9-23.3 RESERVED**9-23.4 RESERVED****9-23.5 BURLAP CLOTH**

Burlap cloth shall meet the requirements of AASHTO M 182, Class 4.

9-23.6 AIR-ENTRAINING AND CHEMICAL ADMIXTURES

Admixtures for use in concrete shall meet the following specifications:

Admixture	Specification	
Air entraining	AASHTO M 154	ASTM C 260
Water Reducing	AASHTO M 194 Type A	ASTM C 494 Type A
Set Retarding	AASHTO M 194 Type B	ASTM C 494 Type B
Water Reducing/Set Retarding	AASHTO M 194 Type D	ASTM C 494 Type D
High Range Water Reducing	AASHTO M 194 Type F and G	ASTM C 494 Type F and G

In addition to the above Specifications, admixtures proposed for use shall contain less than one percent chloride ion (Cl-) by weight of admixture.

Acceptance of admixtures will be based on Manufacturer's Certificate of Compliance. If required by the Engineer, admixtures shall be sampled and tested before they are used.

The use of calcium chloride will not be allowed.

9-23.7 AIR-ENTRAINING AND CHEMICAL ADMIXTURES FOR PRECAST PRESTRESSED CONCRETE

Air-entraining admixture shall meet the requirements of AASHTO M 154. Acceptance will be on the basis of a Manufacturer's Certification of Compliance.

If required by the Engineer, the air-entraining admixture shall be sampled and tested by the SPU Materials Laboratory before use.

Chemical admixtures shall conform to the requirements of AASHTO M 194, Type A, Type B, Type D, or Type F. Approval of specific admixture products shall be required as a part of the annual approval of prestressed fabricators. Chloride ion content of chemical admixtures shall not exceed one percent by weight.

Acceptance will be on the basis of a Manufacturer's Certification of Compliance.

9-23.8 RESERVED**9-23.9 CONCRETE MIXES INCORPORATING FLY ASH**

Concrete mixes incorporating fly ash may be utilized for all classes of concrete, unless otherwise noted in the Contract. Mix proportions will be subject to approval by the Engineer and shall be in compliance with the following conditions:

1. Fly ash may be used to replace up to 15 percent of Portland cement at the rate of 1-1/4 pounds fly ash for each pound of Portland cement replaced. In concrete mix designs where a specific cement content is not

- specified, the fly ash content shall not exceed 15 percent of the total cementitious Material. Cementitious Material shall be the sum of Portland cement plus fly ash.
2. Cement replacement in concrete mixes specifying a cement content shall be subject to strength confirmation testing and approval of the proposed mix by the Engineer for the following classes of concrete:
 - i. Concrete Class A
 - ii. Concrete Class B when used in bridges, Culverts, and retaining walls
 - iii. Concrete Class AX
 - iv. For these classes of concrete, the Contractor shall design the concrete mix to meet an average 28 Day compressive strength of 1.34 times the minimum ultimate compressive strength shown in Section 6-02.3(2) for concrete plants with a coefficient of variation of 20 percent.
 - v. For concrete plants with a coefficient of variation other than 20 percent, the required average strength shall be:
 - vi. $f'_{cr} = (1/(1 - 1.28 V)) \times f'_c$
 where:
 f'_{cr} = required average 28 Day compressive strength
 f'_c = minimum ultimate compressive strength at 28 Days
 V = coefficient of variation (CV) expressed as a decimal i.e. CV=20%, V=0.20
 - vii. The required average 28-Day compressive strength will be determined from five 6 inch by 12 inch cylinders tested in accordance with WSDOT test methods 801 and 811.
 - viii. A CV of 20% will be assumed unless the concrete Supplier can justify a lower value.
 - ix. To establish a CV for a concrete plant, a minimum of 30 sets of two cylinder compression test breaks will be required. The cylinders will be 6 inch by 12 inch test specimens and will be made, handled, and stored in accordance with WSDOT Test Method 809 (Method 1) and tested in accordance with WSDOT Test Methods 801 and 811. Each set of two cylinders will be produced from separate batches of production concrete. The Equipment used for the production concrete *shall* be the same as will be used for the proposed class of concrete.
 - x. The concrete mix design will be approved by the Engineer and verified by submission of ingredients and testing of specimens made in accordance with this mix design prior to the use on the Project.
 3. Cement replacement may be used without strength confirmation testing of the proposed mix for concrete Class C, Class D, and Class DX and for Concrete Class B for applications other than those listed in item 2 above.
 4. In making calculations relative to cement factor or allowable water content, the total cementitious Material shall be considered to be the weight of Portland cement, plus the weight of fly ash substituted.
 5. All concrete of the same class within a Structure shall contain the same proportion of fly ash.
 6. Acceptance of concrete containing fly ash will be on the same basis as for comparable class of concrete without fly ash.

As an alternative to the use of fly ash and cement as separate components, a blended hydraulic cement may be used. Concrete made with blended hydraulic cement shall comply with ASTM C-595-83, Type 1P(MS). In addition, the origin and percentage of fly ash shall be certified on the cement mill test certificate.

Fly ash shall conform to the requirements of ASTM C 618, Class F with optional chemical and physical requirements as set forth in Tables 1A and 2A and with a further limitation that the loss of ignition be a maximum of 1.5 percent.

9-23.10 COLORING AGENT

The coloring agent for matching the color of new concrete to the color of adjacent existing concrete shall be dry lamp black, added to the concrete during mixing in an amount not to exceed 1-1/2 pounds per cubic yard of concrete.

Use of liquid concrete coloring agent will be permitted when approved by the Engineer.

SECTION 9-24 PLASTIC WATERSTOP

9-24.1 MATERIAL

Waterstops shall be fabricated from a plastic compound, the basic resin of which shall be polyvinyl chloride. The compound shall contain such additional resins, plasticizers, inhibitors, or other material that when the Material is compounded, it shall meet the performance requirements given in this Specification.

Single-pass reworked Material of the same composition generated from the fabricator's waterstop production may be used. No reclaimed polyvinyl chloride shall be used.

All waterstops shall be molded or extruded in such a manner that any cross section is dense, homogeneous, and free from porosity and other imperfections.

Waterstops shall be symmetrical in shape, nominally 4 inches in width by 3/16 inch thick, and have a minimum of four ribs on each side of the bulb. The bulb thickness and diameter shall be as noted on the Drawings.

9-24.1(1) TESTS OF MATERIAL

The waterstops shall meet all of the physical and other test requirements of this material as defined in the Corps of Engineers Specifications for Polyvinyl Chloride Water Stop CRD-C572, except that the tear resistance of the material shall be

not less than 160 pounds per inch. The Contractor shall furnish such sample material as required by the Engineer for the purpose of making tests.

SECTION 9-25 WATER

9-25.1 WATER FOR CONCRETE

Water for use with cement in mortar or concrete shall be reasonably clear and free from oil. It shall not contain chlorides calculated as sodium chloride in excess of 2,500 parts per million, nor sulfates calculated as sodium sulfate in excess of 1,000 parts per million. It shall not contain any impurities in amounts sufficient to cause unsoundness or marked change in time of setting in the cement with which it is mixed, nor a reduction in mortar strength of more than 5 percent compared to the results obtained with distilled water.

The properties enumerated above shall be determined in accordance with AASHTO T 26.

9-25.2 WATER FOR IRRIGATION

Water for irrigation shall not contain dissolved or suspended matter which is harmful to the plant Material on which it is to be used.

SECTION 9-26 EPOXY RESINS

9-26.1 GENERAL

These Specifications cover 2-component epoxy resin systems for bonding plastic concrete or mortar to metal or hardened concrete, or for bonding hardened concrete or other materials to hardened concrete.

Epoxy resins used for patching external concrete shall have a concrete-gray color.

The epoxy resin systems shall be furnished in the type, grade, and class as specified according to current ASTM C 881.

9-26.1(1) RESERVED

9-26.1(2) AGGREGATE

Aggregate for epoxy mortar or concrete shall be clean, surface dry and inert (defined as not affecting cure rate or physical properties of the epoxy resin system), and shall be of a quality and gradation suitable for Portland cement mortar or concrete. Sand meeting the requirements of Section 9-03.1(2) will be acceptable.

9-26.1(3) SAMPLING

A representative sample of each component (one pint of each) shall be taken either from a well-blended bulk lot prior to packaging or by withdrawing thief samples from no less than 5 percent of the containers comprising the lot or shipment. Instead of the foregoing, packaged materials may be sampled by a random selection of containers of each component from each lot. Samples shall be submitted to the SPU Materials Laboratory.

9-26.1(4) REJECTION

Except as noted otherwise in Section 9-26, the entire lot of both epoxy components may be rejected if samples submitted for test fail to meet any requirement of Section 9-26.

9-26.1(5) PACKAGING AND MARKING

9-26.1(5)A PACKAGING

The two components of the epoxy resin system furnished under these Specifications shall be supplied in separate containers which are nonreactive with the materials contained. The contents of each container shall be such that the recommended proportions of the final mixture can be obtained by combining one container of one component with one container of the other component.

9-26.1(5)B MARKING

Containers shall be identified as "Component A - contains Epoxy Resin" and "Component B - contains Curing Agent" and shall show the type, grade, class, and mixing directions as defined by these Specifications. Each container shall be marked with the name of the manufacturer, the lot or batch number, the date of packaging, and the quantity contained in pounds and gallons.

Potential hazards shall be so stated on the package in accordance with the Federal Hazardous Products Labeling Act and State of Washington, Department of Labor and Industries Regulations for Shipment of Hazardous Products.

9-26.1(6) CERTIFICATION

If requested by the Engineer, the manufacturer of the epoxy resin system shall provide a Manufacturer's Certificate of Compliance that components A and B meet the requirements of this Specification before a sample will be accepted for testing by the Owner. Such certification shall consist of either a copy of the manufacturer's test report or a statement of the manufacturer, accompanied by a copy of the test results, that components A and B have been sampled and tested. Such certifications shall indicate the date of testing and shall be signed by an authorized agent of the formulator or manufacturer.

9-26.1(7) ACCEPTANCE

Acceptance of a batch lot or shipment of the Material for use on the Project will be on the basis of Laboratory tests of samples, as specified in Section 9-26.1(3) representing the particular batch or shipment of Materials supplied. These tests will be performed at the Laboratory. A period of 10 Days should be allowed for testing, following receipt of samples by the Laboratory.

9-26.2 ADHESIVE FOR LANE MARKERS**9-26.2(1) DESCRIPTION**

The adhesive shall be furnished as two components, each packaged separately. The components shall have the following composition:

Package A	Parts by Weight
Epoxy Resin	100.0
Titanium Dioxide	4.55
Oleophillic Fumed Silica	2.28
Talc	37.97
Package B	
N-Aminoethyl Piperazine	22.53
Nonylphenol	50.88
Carbon Black	0.14
Silica	25.32
Talc	50.63
Oleophillic Fumed Silica	2.28

At the time of use, the contents of packages A and B shall be thoroughly dispersed by mixing. One volume or weight of Package A shall be mixed with one volume or weight of Package B until a uniform gray color is achieved. The maximum acceptable variation in mix ratio shall be five from the 50/50 ratio (45A to 55B or 55A to 45B). The mix ratio shall be determined by analysis for nitrogen percentage in the mixed and cured adhesive.

9-26.2(2) RAW MATERIALS

Raw Materials for the adhesive shall meet the following specifications:

- Epoxy Resin**--Viscosity, 70-100 poise at 25°C; epoxide equivalent 175-200; color (Gardner), 5 maximum; manufactured from epichlorohydrin and bisphenol A. The reactive diluent shall be either butane diol diglycerol ether or para tertiary butyl phenyl/glycidal ether.
- High purity fumed silica**--surface treated with a silicone oil, with the following properties: appearance, fluffy white powder; surface area, N2 B.E.T. method; $100 \pm 20 \text{ M}^2/\text{g}$; weight percent carbon, 4.5 minimum; ignition loss (dry basis) 2 hours at 1,000°C, 7 maximum; specific gravity, 1.8. Moisture, weight percent, 0.5 maximum.
- Talc**--Percent passing 325 mesh screen, 100 percent; oil absorption in grams/100 g. talc, 28-34; Hegman grind in oil, 3 minimum; purity, 98 percent, talc minimum.
- N-Aminoethyl Piperazine** - COLOR (APHA) 50 maximum; amine value, 1250-1350 based on titration which reacts with 3 nitrogens in the molecule; appearance, clear and substantially free of suspended matter.
- Nonylphenol** - Color (APHA) 50 maximum; hydroxyl number, 245-255; distillation range, degrees C at 760 mm, first drop 295 minimum, 5 percent 298 minimum, 95 percent 325 maximum; water, percent (K.F.) 0.05 maximum.
- Carbon Black** - TT-P-343, Form I, Class B.
- Silica**--percent passing through 325 mesh screen, 98 percent minimum. Average particle size, 7 to 10 microns; oil absorption in grams per 100 g. silica, 25 to 31. Hegman grind, 3 minimum. Purity, 98 percent silica (SiO₂) minimum.

9-26.2(3) PHYSICAL REQUIREMENTS OF MIXED ADHESIVE

Mixed adhesive shall be a blend of 1 part of component A and 1 part of component B, as specified in Section 9-26.2(1), and shall meet the following properties:

Gel time (150 g./Batch)	5-10 minutes
Tensile strength 1/16" film between steel blocks cured 24 hours at 70°F. Tested at 70°F	1,000 psi (Min.)
Shore D Hardness	(Cured 24 hrs. at 70°F)
Tested at 70°F	70 – 80
Tested at 120°F	Min. 30
Deformation Temp.	Min. 120°F
Viscosity of Mixed Adhesive ¹	1,000 – 2,000 poise

¹Brookfield to Helipath spindle at 77°F.

9-26.2(4) ACCEPTANCE

Adhesive for lane markers may be accepted by the Engineer based on the Manufacturer's Certificate of Compliance. The manufacturer shall certify that each batch of adhesive conforms to these Specification.

The lot or batch number shall appear on the certificates, on all samples, and on all lots of adhesives delivered. A one pint sample of the A and B components shall be sent to the SPU Materials Laboratory by the Supplier not less than 10 Working Days before using.

SECTION 9-27 CRIBBING

9-27.1 RESERVED

9-27.2 RESERVED

9-27.3 GABION CRIBBING

9-27.3(1) GABION FABRIC

Gabions may be fabricated from either hexagonal twisted wire mesh or from welded wire mesh. Only one type of mesh and protective coating shall be used throughout a structure.

Baskets shall be furnished in the required dimensions with a dimensional tolerance of $\pm 5\%$.

Wire for construction of gabions shall be either galvanized steel wire conforming to ASTM A 641, Class 3, Soft Temper, or aluminized steel wire conforming to ASTM A 809, Soft Temper. The wire shall have a minimum tensile strength of 60,000 psi when tested in accordance with ASTM A 370.

9-27.3(2) GABION BASKETS

Gabion baskets 1 foot or greater in the vertical dimension shall have mesh openings with nominal dimensions not to exceed 4-1/2 inches and the maximum area of any mesh opening shall not exceed 10 square inches.

1. Hexagon Twisted Wire Mesh
 - a. Wire for galvanized or aluminized hexagonal twisted wire mesh shall be nominal sized 0.120 inch galvanized steel wire or aluminized steel wire.
 - b. Hexagonal wire mesh be formed from galvanized or aluminized wire in a uniform hexagonal pattern with nonraveling double twist. The perimeter edges of the mesh for each panel shall be tied to a selvage wire of the same composition as the body mesh and have a minimum diameter of 0.150 inch so that the selvage is at least the same strength as the body of the mesh.
2. Welded Wire Mesh
 - a. Welded wire mesh shall be fabricated from galvanized steel wire having a diameter of 0.106 inch. Wire shall be galvanized prior to fabrication.
 - b. Welded wire mesh shall be formed in a uniform square pattern with openings 3 inches by 3 inches with a resistance weld at each connection in accordance with ASTM A 185.
 - c. If required, a PVC coating shall be fusion bonded onto the welded wire mesh to provide a nominal coating thickness of 0.0216 inch per side with a minimum of 0.0150 inch.
3. PVC Coating (for welded wire mesh only).

Acceptance of PVC coating material shall be by certified test reports of an independent laboratory. The initial properties of PVC coating material shall have a demonstrated ability to conform to the following requirements:

 - a. Specific Gravity — In the range of 1.2 to 1.4, when tested according to ASTM D 792.
 - b. Tensile Strength — Not less than 2,275 psi, when tested according to ASTM D 638.
 - c. Modulus of Elasticity — Not less than 1,980 psi at 100 Strain, when testing according to ASTM D 638.
 - d. Hardness — Shore "A" not less than 75 when tested according to ASTM D 2240.
 - e. Brittleness Temperature — Not higher than 15°F when tested according to ASTM D 746.
 - f. Resistance to Abrasion — The percentage of the mass loss shall be less than 12 percent when tested according to ASTM D 1242, Method B at 200 cycles, CSI-A Abrader Tape, 80 Grit.
 - g. Salt Spray Exposure and Ultraviolet Light Exposure — The PVC shall show no effect after 3,000 hours of salt spray exposure according to ASTM B 117. The PVC shall show no effect of exposure to ultraviolet light with test exposure of 3,000 hours using apparatus Type E and 63°C, when tested according to Practice D 1499 and Practice G 23. After the salt spray test and exposure to ultraviolet light as specified above, the PVC coating shall not show cracks, blister, split, nor show a noticeable change of color. In addition, the specific

gravity, tensile strength, modulus of elasticity, and resistance to abrasion shall not change more than 6, 25, 25, and 10 percent respectively from their initial values.

9-27.3(3) GABION MATTRESSES

Gabion baskets less than 1 foot in the vertical dimension shall have mesh openings with nominal dimensions not to exceed 3.3 inches, and the maximum area of any mesh opening shall not exceed 6 square inches.

1. Hexagonal Twisted Wire Mesh

- a. Wire for galvanized or aluminized hexagonal twisted wire mesh shall be nominal sized 0.086 inch galvanized steel wire or aluminized steel wire.
- b. Hexagonal wire mesh shall be formed from galvanized or aluminized wire in a uniform hexagonal pattern with nonraveling double twisted. The perimeter edges of the mesh for each panel shall be tied to a selvaige wire of the same composition as the body mesh and have a minimum diameter of 0.1062 inch so that the selvaige is at least the same strength as the body of the mesh.

2. Welded Wire Mesh

- a. Welded wire mesh shall be fabricated from galvanized steel wire having a diameter of 0.080 inch. Wire shall be galvanized prior to fabrication.
- b. Welded wire mesh shall be formed in a uniform rectangular pattern with openings 1-1/2 inches by 3 inches with a resistance weld at each connection in accordance with ASTM A 185.
- c. If required, a PVC coating shall be fusion bonded onto the welded wire mesh to provide a nominal coating thickness of 0.0216 inch per side with a minimum of 0.0150 inch. The PVC coating shall be in conformance with Section 9-27.3(2).

9-27.3(4) FASTENERS FOR BASKET ASSEMBLY

The lacing wire shall be a nominal sized 0.0866 inch galvanized steel wire or aluminized steel wire. Lacing wire shall have the same coating as the basket mesh.

Spiral binders, if used for joining welded wire panels shall be formed from 0.106 inch nominal diameter steel wire with a 3 inch pitch having the same specifications and coating as the wire mesh. Lacing wire may be used in lieu of spiral binders.

Alternate fasteners for basket assembly shall remain closed when subjected to a 600 pound tensile force when confining the maximum number of wires to be confined. Installation procedures and test results for alternate fasteners shall be submitted for approval.

Internal connecting wires shall be the same as required for lacing wire. *Alternate stiffeners acceptable to the gabion manufacturer may be used if found acceptable to the Engineer.*

9-27.3(5) NONRAVELING CONSTRUCTION

The wire mesh shall be fabricated in a manner to be nonraveling. This is defined as the ability to resist pulling apart at any of the connections forming the mesh when a single strand in a section of mesh is cut.

9-27.3(6) STONE

Stone for filling gabions shall have a Degradation Factor of at least 30. The stone shall be dense enough to pass the unit-weight test described in Section 6-09.3(6)F. Stone shall meet the following requirements for gradation:

Sieve Size	Percent Passing
8" square	100
6" square	75-90
4" square	0-10
Fracture	75

All percentages are by weight.

SECTION 9-28 SIGNING MATERIALS AND FABRICATION

9-28.1 SIGNS

9-28.1(1) GENERAL

Signs to be mounted on wood utility poles (other than Seattle City Light) and signs installed overhead shall be High Density Overlay plywood. Other signs shall be either High Density Overlay plywood or sheet aluminum.

Parking and pedestrian control signs shall be nonreflectorized. All other *Traffic* signs shall be reflectorized.

STOP and YIELD sign backs and edges shall be painted with one coat of red enamel to match the red on the sign face.

Regulatory and warning signs shall have rounded corners with the exception of STOP signs. All other signs shall have square cut corners. Borders for signs having square cut corners shall have a corner radius approximately 1/8 of the lesser side dimension of the sign up to a maximum radius of 12 inches. For signs with rounded corners, the borders shall be concentric with the rounded corners.

9-28.1(2) PLYWOOD

Plywood signs shall be constructed of High Density Overlay plywood, meeting the requirements of "Products Standard PS 1-83 for Softwood Plywood, Construction and Industrial" published by the Product Standards Section of the U.S. Department of Commerce. The plywood shall be free of contaminants which would adversely affect the application or life of the sheeting to be applied. Face veneers shall be Grade B or better.

Core and crossband veneers shall be solid. Core veneers shall be jointed, and core gaps shall not exceed 1/8 inch in width. The entire area of each contacting veneer surface shall be bonded with a waterproof adhesive that meets the requirements of the U.S. Department of Commerce for exterior type plywood.

The overlay shall be of the high density type. It shall have a minimum weight of 60 pounds per thousand square feet of surface and shall be at least 0.012 inches thick before pressing. The overlay shall have a sufficient resin content to bond itself to the plywood, with a minimum resin content of 45 percent based on the dry weight of the impregnated fiber.

Thickness - Single Panel Plywood Signs:

Up to 18 inches inclusive in width	3/8 inch
Over 18 inches to 36 inches inclusive in width	5/8 inch
Over 36 inches in width	3/4 inch
Overhead signs	3/4 inch

Street designation signs and signs mounted on span wires or mast arms shall have the sign back and edges primed with 1 coat of white exterior enamel undercoat and finished with 1 coat of International Green (Forest Green) exterior enamel. All other plywood signs shall have only the edges primed with 1 coat of white exterior enamel undercoat and finished with 1 coat of white exterior enamel. The primer shall be as recommended by the Supplier of the finish coat. The finish enamel shall meet the requirements of Federal Specification TT-E-489.

9-28.1(3) SHEET ALUMINUM

Sheet aluminum signs shall be constructed of Material conforming to ASTM B209, alloy 6061T6, or alloy 5052-H36 or H38. Alloy 50D5-H34 may be used for sign refacing.

After the sheeting has been fabricated, it shall be degreased and etched by immersion for a minimum of 5 minutes in a 6 ounce per gallon caustic etch solution at 120°F, followed, in order, by a water rinse, de-oxidation, water rinse, hot water rinse, and drying. The etching process shall produce a dull aluminum finish on both sides of the panel which lasts the life of the sign. The treated panel surface shall be compatible with the sign face sheeting to be applied. The Contractor may use an Alodine 1200 application for single panel signs in lieu of the above treatment. Reflectorized aluminum signs shall be comprised of panels 4 feet or less in width. The Contractor shall use the widest panels possible. Parts necessary for assembly shall be constructed of aluminum. Sheet aluminum thickness shall be 0.080 inch.

Metal shall be protected by handling with a suitable device or with clean canvas gloves between cleaning and etching operations and the application of sign face sheeting.

Sheet aluminum edges shall be filed smooth to eliminate sharp edges and burrs.

9-28.1(4) REFLECTIVE SIGN FACE SHEETING

Reflective sheeting shall consist of spherical lens elements embedded within a transparent plastic or adhered to a synthetic resin and encapsulated by a transparent plastic. The sheeting shall have a flat, smooth outer surface, be weather resistant, and have a pre-coated adhesive backing with a protective liner.

The sheeting shall have the following minimum brightness values expressed as average candle power per foot candle per square foot of Material. Measurements shall be conducted in accordance with standard testing procedures for reflex-reflectors in Federal Specification L-S-300.

The brightness of the reflective sheeting, totally wet by rain, shall be not less than 90 percent of the above values. Wet performance measurements shall be conducted in conformance with the Standard Rainfall Test specified in Federal Specification L-S-300C.

The diffuse day color of the reflective sheeting shall be visually evaluated by comparison with the applicable Highway Color Tolerance Chart. Color comparisons shall be made under north daylight or a scientific daylight having a color temperature of from 6500 degrees to 7500 degrees Kelvin. Color shall be illuminated at 45 degrees and viewed at 90 degrees.

The sheeting surface shall be smooth and facilitate cleaning and wet performance and exhibit 85 degree glossmeter rating of not less than 50 (ASTM D 523). The sheeting surface shall be readily processed and compatible with transparent and opaque process colors and show no loss of the color coat with normal handling, cutting, and application. The sheeting shall permit cutting and color processing at temperatures of 60°F to 100°F and 20 to 80 percent relative humidity.

The sheeting surface shall be solvent resistant such that it may be cleaned with gasoline, VM&P Naptha, mineral spirits, turpentine, methanol, or xylol.

The embedded lens sheeting, when applied according to manufacturer's recommendations to cleaned and etched 0.020 inch x 2 inch x 8 inch aluminum, conditioned 24 hours, and tested at 72°F and 50 percent relative humidity, shall be sufficiently flexible to show no cracking when bent around a 3/4 inch diameter mandrel.

Conditioned for 48 hours, the tensile strength of the embedded lens sheeting shall be 5 to 20 pounds per inch width when tested in accordance with ASTM D 828. Following liner removal, the sheeting shall not shrink more than 1/32 inch in 10 minutes nor more than 1/8 inch in 24 hours in any dimension per 9 inch square at 75°F and 50 percent relative humidity.

The encapsulated lens sheeting, with liner removed, conditioned for 24 hours at 72°F and 50 percent relative humidity, shall be sufficiently flexible to show no cracking when bent around a 1/8 inch diameter mandrel with adhesive side contacting the mandrel.

The protective liner attached to the adhesive shall be easily removable by peeling without soaking in water or other solvents.

The pre-coated adhesive backing shall be a tack free heat activated type or a pressure sensitive type, either of which shall adhere to the sheeting without the necessity of additional coats of adhesive.

The adhesive shall form a durable bond to smooth the corrosion-resistant and weather-resistant surfaces and permit the reflective sheeting to adhere securely 48 hours after application at temperatures of 30°F to 200°F. The adhesive bond shall be sufficient to render the applied sheeting vandal-resistant and prevent its shocking off when jabbed with a spatula at 10°F. The sheeting shall resist peeling from the application surface when a 5-pounds per inch width force is applied as outlined in ASTM D 903.

With Embedded Lens Elements:									
	Div. Ang.			Div. Ang.			Div. Ang.		
	0.2deg	0.5deg	1.50	0.2.	0.5deg	1.5deg	0.2deg	0.50	1.5deg
Inc. Ang.	Silver-White #1			Silver-White #2			Yellow		
-4deg	70.0	30.0	4.0	80.0	41.0	4.0	50.0	25.0	5.0
40deg	14.5	8.5	1.5	16.5	9.5	2.0	11.5	7.0	1.5
Inc. Ang.	Red			Blue			Green		
-4deg	14.5	7.5	1.0	4.0	2.0	0.6	9.0	4.5	1.0
40deg	3.0	1.5	0.3	0.9	0.4	0.08	1.8	1.5	0.2
Inc. Ang.	Orange			Brown			-----		
-4deg	25.0	13.5	1.5	1.0	0.35	0.1			
40deg	1.0	0.8	0.1	0.2	0.1	0.01			

With Encapsulated Lens Elements:						
	Div. Ang.			Div. Ang.		
	0.2deg	0.5deg	1.5deg	0.2deg	0.5deg	1.5deg
Inc. Ang.	Silver White			Yellow		
-4deg	250.0	95.0	4.0	170.0	62.0	3.0
40deg	120.0	54.0	2.0	80.0	35.0	1.5
Inc. Ang.	Orange			Green		
-4deg	70.0	25.0	1.1	30.0	12.0	0.5
40deg	33.0	14.0	0.5	14.0	6.8	0.2
Inc. Ang.	Red			-----		
-4deg	35.0	13.0	0.7			
40deg	16.0	7.4	0.3			

9-28.1(5) NON-REFLECTIVE SIGN FACE SHEETING

The non-reflective sheeting shall consist of a white plastic film having a smooth, flat outer surface. The sheeting shall be weather-resistant and have a protected pre-coated adhesive backing.

9-28.1(6) SHEETING APPLICATION

Plywood sign faces shall be cleaned with lacquer thinner, heptane, benzene, or solvent recommended by the sheeting manufacturer. The surface shall be sanded with light sandpaper or steel wool and wiped dry and clean with clean cloth. Aluminum sign faces shall be cleaned with a solvent recommended by the sheeting manufacturer.

Sign face sheeting shall be applied by a vacuum applicator recommended by the sheeting manufacturer, or by a continuous roll applicator.

Heat-activated adhesive backed sheeting shall be applied by the vacuum method. The adhesive on the back of the sheeting shall be activated by a minimum temperature of 185°F and with a minimum vacuum pressure of 25 inches of

mercury. This operation shall be in effect for a minimum of 3 minutes on plywood and 5 minutes on metal. After aging for 48 hours at 75°F, the adhesive shall form a bond equal to or greater than the strength of the sheeting.

Pressure sensitive adhesive backed sheeting shall be applied by a continuous roll applicator. The process shall be in conformance with the recommendation of the sheeting manufacturer.

Edges and splices of sign face sheeting shall be coated with an edge sealer recommended by the sheeting manufacturer.

9-28.1(7) LETTERS, ARROWS, AND SYMBOLS

Letters, arrows, and symbols shall be of the type, size, and color specified on the Drawings, in the Specifications or WSDOT Sign Fabrication Manual, and the "Standard Highway Signs" by United States Department of Transportation.

Letters, arrows, and symbols shall be of Material compatible with the sign surface Material, as recommended by the sign surface manufacturer or approved by the Engineer.

9-28.1(8) HARDWARE

Bolts, nuts, and washers shall be of the same Material for each attachment. All parts necessary for assembly shall be constructed of the following Materials:

Hardware	Specification
Bolts	ASTM B 209, 2024-T4 Aluminum
	ASTM A 307 Steel
	ASTM F 593 Stainless Steel
Washers	ASTM B 209, 2024-T4 Aluminum
	ASTM A 36 Steel
	ASTM A 240 Stainless Steel
Nuts	ASTM B 209, 6061-T6 Aluminum
	ASTM A 307 Steel
	ASTM F 594 Stainless Steel
Locknuts	ASTM B 211, 2017-T4 Aluminum
	ASTM A 307 Steel
	ASTM F 594 Stainless Steel
Rivets	ASTM B 209, 6061-T6 Aluminum
	ASTM B 316, 6053-T61 Aluminum
Post Clips	ASTM B 179, 356-T6 Aluminum
Wind Beams	ASTM B 209, 6061-T6 Aluminum
Angle and Z-Bar	ASTM B 209, 6061-T6 Aluminum
	ASTM A 36 Steel
Strap and Mounting Bracket	ASTM A 276 Stainless Steel

All steel parts shall be galvanized per ASTM A 123. Steel bolts and related *connecting* hardware shall be galvanized per ASTM A 153.

9-28.2 POSTS

9-28.2(1) WOOD SIGN POST

Wood sign post shall be Standard Grade Western Red Cedar. The top of each sign post shall be chamfered at approximately 45 degrees.

STOP and YIELD sign posts shall be painted with 2 coats of white primer. The first coat shall be quick dry alkyd white primer, meeting the requirements of *Federal Specification TT-P-664D*. The second coat shall be reinforcing white primer, semigloss oil base, meeting the requirements of *Federal Specification TT-P-102E (A-A-3067)*. They shall also have alternating 6 inch red and white paint stripes of sash and trim type exterior enamel, as indicated on Standard Plan no. 625 for Wood Traffic Sign Posts.

9-28.2(2) PARKING METER POST

9-28.2(2)A GENERAL

Parking meter post mounted with a parking meter and with no sign attached to the post shall have a 2-1/2 inch nominal ASTM A 53, Schedule 40 galvanized standard steel pipe sleeve fitted loosely over the exposed meter post full length. On the bottom, the sleeve shall make contact with the canopy for surface mounted posts or with the finished grade for direct burial posts. On the top, the sleeve shall make contact with the parking meter base. Standard Plan no. 629 shows the sleeve on a direct burial post. Direct burial and surface-mounted meter posts not used for a parking meter and used only for parking sign or other type sign, shall have a 2-3/8 inch galvanized steel cap securely fitted over the top of the post as specified in Section 8-21.3(2)B and as shown on Standard Plan nos. 627 and 628.

9-28.2(2)B DIRECT BURIAL PARKING METER POST

See Standard Plan no. 629. Direct burial parking meter post shall be fabricated from 2 inch nominal diameter standard ASTM A 53, schedule 40 galvanized pipe, 46 inches in length, and with the bottom 3 inches flattened. Two 1/4 inch weep holes are required. The buried post base shall be backfilled, and mounded for drainage, with very quick setting and very strong cement grout, such as "jet-set cement", having the following properties:

Compressive Strength	ASTM C 109	8,000 psi. min. in 28 days
Bond Strength	ASTM C 1042	500 psi. min. in 1 day
Shrinkage	ASTM C 596	Less than 0.10%
Set-time	ASTM C 191	Initial set in 8 to 10 minutes Final set in 15 to 20 minutes

Cement grout meeting these requirements is "jet-set cement" and can be obtained from Jet Set Northwest Inc., Seattle, Wa., or approved equal.

9-28.2(2)C SURFACE MOUNTED PARKING METER POSTS

Bolted-down parking meter and parking sign posts shall be fabricated from 2 inch nominal diameter standard ASTM A 53, schedule 40 galvanized steel pipe, 40 inches in length, with 5/16 x 5 x 5 inch ASTM A 36 steel base plate. The meter post base "canopy", also known as "collar", shall be made of 0.062 inch 2-5-0 aluminum as shown on Standard Plan no. 627.

9-28.2(3) RESERVED**9-28.2(4) STREET NAME SIGN POST**

Street name sign post shall be 2-1/2 inch inside diameter x 10 feet 6 inches standard weight galvanized steel pipe, with the bottom 6 inch end section flattened to form a wedge. For details, see Standard Plan no. 622.

9-28.3 RESERVED**SECTION 9-29 PAVEMENT MARKING****9-29.1 GENERAL**

Materials for pavement markings shall be paint or plastic Material as specified in the Contract.

9-29.2 PAINT**9-29.2(1) GENERAL**

Paint shall comply with Specifications for no heat, instant dry pavement marking. White sharp sand shall comply with the Specifications for E-16 sand.

9-29.2(2) PHYSICAL PROPERTIES OF THE COATING

1. Viscosity (in Krebs Units).
 - a. At 70°F - 70-75 KU
 - b. At 50°F - 86 KU max.
 - c. At 122°F - 66 KU min.
2. Weight per gallon at 70°F.
 - a. White 12.00 pounds min.
 - b. Yellow 12.10 pounds min.
3. Contrast ratio at spread rate of 320 sq. ft. per gallon.
 - a. White .92 min.
 - b. Yellow .92 min.
4. Daylight reflectance (at 10 mils wet film thickness).
 - a. White 86 min.
 - b. Yellow 64 min.
5. Non-volatile content (total at 212°F.) - 65% to 68%.
6. Pigment content of total weight - 53% max.
7. Dispersion, Hegman standard gauge - 2 min.
8. Flexibility - Pass 1/2-inch mandrel bend.
9. Dry to no-pick-up (beaded) - 15 to 35 sec.
10. Bleeding over asphalt - 90% min.
11. The Material shall not show evidence of heavy caking or settling which requires mechanical means to return the product to usable condition for a period of one year from the date of manufacture or date first shipped to the Owner.
12. Color - The paint shall match a standard color sample which may be obtained upon application to the SPU Materials Laboratory.

9-29.2(3) TEST METHODS

The properties enumerated in these Specifications shall be determined in accordance with the following methods of test:

1. Viscosity - Federal test method standard 141A, Method #4281.
2. Weight per gallon - Federal test method standard 141A, Method #4184.1.
3. Contrast ratio - Federal test method standard 141A, Method #4121 procedure "B", method "B".
4. Daylight reflectance - Federal test method standard 141A, Method #6121 using standards as prescribed in Par. 1.3.2.
5. Non-volatile content - Federal test method standard 141A, Method #4021.1.
6. Pigment content - Federal test method standard 141A, Method #4021.1.
7. Dispersion - Federal test method standard 141A, Method #4411.1.
8. Flexibility - The paint shall show no cracking, flaking, or loss of adhesion when tested in the following manner:
9. Apply a wet film thickness of .005 inches with a film applicator to a 3 x 5 tin panel weighing 0.39 to 0.51 lbs. per square foot previously cleaned with benzene and lightly buffed with steel wool. Dry the paint film at 70°F to 80°F. in a horizontal position for 18 hours, then bake in an oven 3 hours at 212°F ± 4°F. Cool to room temperature for at least 1/2 hour and bend over a 1/2 inch diameter rod and examine.
10. Dry to no-pick-up - The reflectorized line, when applied at a rate of 10 mils wet film thickness and 4 pounds of glass spheres per gallon of paint, shall dry to no-pick-up in 15 to 35 seconds. For test purposes, the line shall be applied using a striper with accurate thickness control capable of maintaining a uniform thickness with 4 pounds of glass spheres per gallon either dropped or blown onto the stripe. The line shall be dry to no-pick-up within specified time range when the *pavement* temperature is 55°F. or more and the relative humidity is 50 percent or less, providing that the *pavement* is dry. Dry to no-pick-up tests will be performed by having a standard size sedan or equivalent test vehicle, coast across the paint stripe (no turning or accelerating). A successful no-pick-up test will be considered one in which at least 3 out of 4 samples show no visible paint from the stripe being tracked onto the adjacent *pavement* when viewed standing 50 feet from the point where the test vehicle crosses the stripe. All paint samples shall have successfully completed all lab tests prior to the no-pick-up test being performed. All field testing shall be performed blind in that the persons conducting the field test shall have no knowledge of which sample is from which manufacturer. All testing shall be performed without the manufacturer's representatives present. Each manufacturer will be provided test results for their sample(s) upon request.
11. Bleeding over asphalt - ASTM D 969 using substrate as in Par. 3.2 except reflectance measurement over asphalt paper area is compared to reflectance measurement over taped area.
12. Reflectance over asphalt paper area X 100 = % Bleeding Reflectance over taped area or asphalt.

9-29.2(4) COMPOSITIONAL REQUIREMENTS

1. **Pigment Composition:** Pigments shall be first quality paint grade pigments. Medium chrome yellow for the yellow traffic paint shall meet the requirements of ASTM D 211-67, Type III. The Titanium Dioxide for the white traffic paint shall meet the requirements of ASTM D 476-73 Type II, III or IV. The inert or filler pigments *shall* be of a type and quality generally recognized as first quality paint grade products and shall not contribute to settling of the paint in storage or be so hard as to cause excessive wear of the spray application Equipment.
2. **Vehicle or Resinous Binder Composition:** The vehicle may be any combination of natural or synthetic resinous Materials. Chlorinated rubber combined with other natural and/or synthetic resins and plasticizers is the preferred system. All resins used *shall* be permanently capable of re-dissolving in the solvent combination used in the paint. Therefore, resins which dry by the process of oxidation and/or polymerization such as alkyd resins are specifically excluded as suitable resinous binders in this Specification. The purpose of the above requirement is to minimize build-up of the paint on the sides of tanks, paint lines, and clogging of spray Equipment from undissolvable skins.

9-29.3 THERMOPLASTIC

One of the following types of thermoplastic *pavement* marking Material Types "A" or "B" shall be used at the Contractor's option and in compliance with the manufacturer's recommendations:

Type "A": Hot-laid, liquid thermoplastic Material, containing reflective glass bead (with additional glass beads applied separately), 120 mil (3.0 millimeters) or greater thickness. The approved thermoplastic Material Suppliers are as follows:

1. Lafrentz brand, 125 mil thickness, hot extruded thermoplastic manufactured by Lafrentz Road Services Ltd., Edmonton, Alberta, Canada T6E4N7, or
2. Catatherm ABITOL formulation, 125-mil thickness, hot extruded thermoplastic manufactured by Ferro Corporation, Cataphote Division, P.O. Box 2369, Jackson, Mississippi 39205, or
3. M.L.E. Code #R200/80 formulation, 125-mil thickness, hot extruded thermoplastic manufactured by M.L.E. Industries Ltd., Calgary, Alberta, Canada T2C1N6, or
4. Pave-Mark SD formulation, 125-mil thickness, hot extruded thermoplastic manufactured by Pave-Mark Corporation, Smyrna, Georgia 30081.

Type "B": Cold-laid, prefabricated glass bead reflective thermoplastic ribbon, 60 mil (1.5 millimeters) or greater thickness.

The approved thermoplastic Material Suppliers are as follows:

1. Prismo brand thermoplastic *pavement* marking Material, 60 mil thickness (HT60), coated with pressure sensitive adhesive, manufactured by Prismo Universal Corporation, 300 Lanidex Plaza, Parsippany, N.J. 07054, or
2. Prismo brand thermoplastic *pavement* marking Material, 90 mil thickness (HT90), coated with pressure sensitive adhesive, manufactured by Prismo Universal Corporation, 300 Lanidex Plaza, Parsippany, N.J. 07054, or
3. 3M, Stamark brand pliant polymer *pavement* marking film, 60-mil thickness, coated with pressure-sensitive adhesive, manufactured by 3M Company, 3M Center, St. Paul, Minnesota 55101.

The glass beads shall comply with Specifications for Type II waterproof overlay glass spheres.

The skid resistance of the Material when installed on the roadway shall be not less than 40 BPN when tested with a British Portable Tester in accordance with ASTM E 303.

Primer, if required, shall be as recommended by the thermoplastic Material manufacturer.

9-29.4 PRESSURE-SENSITIVE TAPE

Pressure-sensitive tape shall be a 4 inch wide, pressure-sensitive, reflective-type tape of the form suitable for marking asphalt and concrete pavement surfaces. Biodegradable tape with paper backing is unacceptable.

The following pressure-sensitive tape has been approved as a temporary pavement marking tape:

3-M Scotch name brand *pavement* marking tape, coated with pressure-sensitive adhesive, manufactured by 3-M Company, 3-M Center, St. Paul, Minnesota 55101.

Surface preparation and application shall be in conformance with all the manufacturer's specifications.

SECTION 9-30 WATER DISTRIBUTION AND TRANSMISSION MATERIALS

9-30.0 GENERAL

All Materials for water distribution and transmission shall be new. Materials used for temporary Water Main and for temporary service connection purposes may be either new or previously used materials and shall be subject to Seattle Public Utilities' Water Operation's inspection and approval prior to installation.

Prior to ordering any pipe to be used in a potable water supply, the Contractor shall submit the Material source as required by Section 1-06.1 and shall obtain the Engineer's approval.

All direct and indirect drinking water system components which come in contact with potable water shall have National Sanitation Foundation certification.

9-30.1 PIPE

All pipe and fittings shall be clearly marked with the manufacturer's name, type, class, and thickness as applicable and shall be marked on the component at the place of manufacture. Marking shall be legible and permanent under normal conditions of handling and storage.

9-30.1(1) DUCTILE IRON PIPE

1. Ductile iron pipe shall be centrifugally cast in 18-foot nominal lengths shall be marked conforming to AWWA C151. Ductile iron pipe shall have a cement-mortar lining conforming to AWWA C104. Ductile iron pipe to be joined using restrained joints shall be Standard Thickness Class 52.
2. Non-restrained joints shall be rubber gasket, push-on type, or mechanical joint conforming to AWWA C111.
3. Restrained joints shall be as specified in Section 9-30.2(6).
4. Coatings, other than those required in item 1 above, shall comply with Section 9-30.1(6).
5. Pipe with threaded flanges shall not be used.

9-30.1(2) RESERVED

9-30.1(3) RESERVED

9-30.1(4) STEEL PIPE

9-30.1(4)A STEEL PIPE LESS THAN 4 INCHES DIAMETER

Steel pipe less than 4 inches in diameter shall conform to ASTM A 53, schedule 40 and shall be hot dip galvanized inside and out, including the couplings. The pipe sections shall be coupled by malleable iron screw coupling in accordance with ANSI Specification B16.3.

9-30.1(4)B STEEL PIPE 4 INCH DIAMETER AND LARGER

Steel pipe 4 inches in diameter and larger shall conform to AWWA C200. The type of protective coating and lining and other supplementary information required by AWWA C204 will be included in the Contract.

9-30.1(5) PLASTIC PIPE AND ASBESTOS CEMENT PIPE

Polyvinyl chloride (PVC), polyethylene, polybutylene, and asbestos cement material pipe shall not be used as Water Main to convey potable water.

9-30.1(6) PIPE COATINGS**9-30.1(6)A SPECIAL PIPE COATINGS**

Special pipe coatings shall be in accordance with the Contract.

9-30.1(6)B MULTI-LAYERED POLYETHYLENE TAPE COATING (MULTI-LAYERED POLYETHYLENE ENCASEMENT)

See Section 9-30.1(6)D for polyethylene (film wrap) encasement.

Acceptable Suppliers of multi-layered polyethylene tape coating shall be Polyken YGIII as manufactured by Kendall Company, or Tapecoat CT 10/40 W as manufactured by Tapecoat Company, or approved equal. The multi-layered polyethylene tape coating shall conforming to AWWA C105, and shall meet the following requirements:

1. The multi-layered polyethylene tape coating system shall consist of the following components:
 - a. One layer of pipeline coating primer and 20 mil inner wrap.
 - b. One layer of pipeline wrap coating, 30 mils minimum thickness.
 - c. One additional layer of outer wrap coating, 30 mils minimum thickness.
2. The primer shall be fast drying and shall form an instantaneous, firm bond when the adhesive on the tape coating comes in contact with the primed pipe surface. Coating primer shall be compatible with the adhesive and shall be from the same manufacturer.
3. The inner wrap coating shall consist of polyethylene backing with a butyl-based adhesive laminated to one side of the backing. The polyethylene backing and adhesive shall be made by the calendaring process in order to ensure the maximum bonding of the adhesive to the backing. The adhesive shall be formulated so that it forms a firm bond upon contact with the primed pipe surface.
4. The pressure sensitive adhesive outer wrap shall consist of a polyethylene backing with a butyl-adhesive laminated to one side of the backing. The pressure sensitive adhesive on the outer wrap shall form a firm continuous bond to the backing of the tape coating.
5. Cutbacks on the spigot end shall be 6 inches or less and shall be made with a cutting device that is guided from the end of the pipe to ensure a straight, uniform cutback. No cutback shall be made on the bell end of the pipe.
6. Following the application of the outer wrap, the coating shall be electrically tested for holidays with a pulse tape holiday detector. The detector voltage range for this coating is 7000-9800 volts. The testing shall conform to NACE RP-02-74.
All defects electrically detected shall be repaired by priming and patching with a suitable primer and tape as specified by the manufacturer and approved by the Engineer.
7. Accessory Tape. Accessory tape for fittings and specials shall be YG III as manufactured by Kendall Co., or approved equal. The accessory tape shall conform to AWWA C209, and shall meet the following requirements:
 - a. One layer of pipeline coating primer and 50 mil inner wrap.
 - b. One layer of 35 mil outer wrap.

The primer shall be fast drying and shall form an instantaneous, firm bond when the adhesive on the tape coating comes in contact with the primed pipe surface.

The pressure sensitive adhesive outer wrap shall consist of a polyethylene backing with a butyl-adhesive laminated to one side of the backing. The pressure sensitive adhesive on the outer wrap shall form a firm continuous bond to the backing of the tape coating.

9-30.1(6)C THERMOPLASTIC POWDER COATING**9-30.1(6)C1 GENERAL**

The powdered thermoplastic Material shall consist of acid modified polyolefin elastomer to which any stabilizers, pigments, or other additives necessary to meet the performance requirements of this Specification have been added by extrusion compounding. The thermoplastic powder shall be suitable for factory application by fluid bed dipping, and or elastic/flock deposition method. For on-site application, other application methods such as controlled flame spraying are acceptable if carried out by an approved applicator. When applied to a substrate in accordance with the guidelines agreed by the manufacturers and approved applicators, the powder shall form a coating which meets or exceeds all requirements of this Specification.

9-30.1(6)C2 QUALITY ASSURANCE

Surface preparation, application and curing of powder coating, and testing and touch-up of coating shall be performed procedures.

9-30.1(6)C3 SURFACE PREPARATION

The pipe or valves and fittings shall be prepared for coating in accordance with the SSPC SP10 near white blast with a 2-3 mil profile. After proper surface preparation, the parts shall be kept free from fingerprints, dust, flash rust or other contamination. The coating shall be accomplished within two hours of blasting.

9-30.1(6)C4 APPLICATION OF POWDER COATING**Powder Coating**

PPA 571 thermoplastic powder coating, as manufactured by Plascoat Systems Limited or an approved equal.

Masking

All masking, where required, shall be done using a high powder coating masking tape.

Preheating

All parts shall be preheated to a maximum temperature of 240°F before coating is applied.

A Raytek RAYNGER ST SERIES noncontact infrared temperature measurement tool or similar device shall be used for determining coating temperature.

Preheating shall be done using a gas fired convection oven or equivalent.

Coating With Electrostatic Deposition

After the part has been preheated to the 240°F temperature followed by the powder application to the surface of the part using a corona powder coating discharge gun, a negative polarity is required and a voltage of 30kv is recommended. The powder is applied across the total surface of the part, taking care that the powder is applied in a level and homogenous build. The coating shall be applied to a dry film thickness of 25 to 30 mil and be totally free of holidays/pinholes.

It is then necessary to convey the part to the oven which shall be set between 285°F and 385°F in order to complete flowing out of powder.

The coating shall be smooth, even and free of runs, sags, streaks and overspray.

Coating With Fluid Bed Dip System

After the part has been preheated to 240°F, the part is then dipped into a fluidized bed of powder and left for a prescribed time to accomplish a coating thickness of 25 to 30 mil.

The part *shall* be conveyed to the oven for a complete flowing of the powder.

The coating shall be smooth, even, and free of runs, sags, streaks and overspray.

9-30.1(6)C5 TESTING**Holidays**

After completing the coating process, the part *shall* be cooled to ambient temperature and then electrically tested for holidays with a Tinker & Rasor AP/S1 holiday detector or equivalent. The voltage should not exceed 6kv for a 25 mil coating. The testing shall conform to NACE RP-02-74. All defects electrically detected shall be repaired by the following method. Clean the area around the holiday/pinhole using mineral sprits, acetone or alcohol. Immediately after cleaning, heat should be applied to the coating surrounding the pinhole to re-melt and flow the coating over the holiday/pinhole repair.

Thickness

Each coated part shall be tested for coating thickness using an electronic coating thickness gauge such as Qua Nix 1500 or equivalent and the test results shall be submitted to the Engineer within 3 Working Days of the testing.

9-30.1(6)C6 FIELD REPAIR AND TOUCH-UP

Damaged coating or repair of cutback areas may be repaired after proper substrate preparation. Exposed substrate should be thoroughly cleaned of corrosion products and contamination to expose bare metal. Abrasive techniques (wire brush, sandpaper, sandblast, etc.) followed by cleaning with mineral sprits, acetone or alcohol are recommended. Immediately after cleaning heat should be applied to the coating adjacent to the damaged area to re-melt and flow the coating over the damaged area. If required, additional PPA571 powder may be added and melted to insure proper installation of a homogenous protective coating of sufficient thickness.

Major repairs (large areas) may require a Contractor with proper training and Equipment to complete a fault-free field repair. If the Contractor feels that the level of damage is such that a fault-free repair cannot be attained then removal of the damaged item for re-coating should be considered.

9-30.1(6)C7 MATERIAL REQUIREMENTS**Test Conditions**

Unless otherwise specified *in the Contract*, the testing conditions shall be in accordance with ASTM D 3924 at standard Conditions: 73.5°F ±3.5°F, 50% ±5% relative humidity.

Specific Gravity

Specific gravity of the powder thermoplastic coating Material shall be between 0.90 and 0.97. Specific gravity shall be determined in accordance with method B specified in ASTM D 729

Color

Color of the thermoplastic powder coating shall be specified by the purchaser and evaluated for conformance in accordance with ASTM D 1729.

Flexibility

The thermoplastic powder coating shall exhibit no cracking, peeling, or loss of adhesion when bent (coated side in tension) 180 degrees over a conical mandrel in accordance with ASTM D 522, Test Method B. Panels shall be examined immediately after bending.

Adhesion

The thermoplastic powder coating shall exhibit a minimum of 1000 psi adhesion to the aluminum and steel substrates in accordance with ASTM D 4541.

Thermal Shock Resistance

The applied thermoplastic powder coating shall withstand 10 temperature cycles without cracking, checking, or disbonding. Cycles should be from + 40°C to - 40°C.

Impact Resistance

The applied thermoplastic powder coating shall resist minimum direct and reverse impacts of 36 inch-pounds without cracking, disbonding or holiday formation as determined by visual inspection. Test panels shall be impacted in accordance with ASTM D 2794 using a 2 pound weight with a 0.5" diameter indenter dropped from a height of 18".

Abrasion Resistance

Weight loss from the applied thermoplastic powder shall not exceed 90 milligrams. Test panels shall be tested for 1000 cycles using a Taber Abrader apparatus with CS-17 wheels and 1000 gram weights in accordance with ASTM D 4060. Weight loss shall be determined immediately after test to three significant figures.

Salt Spray Resistance

Unscribed: There shall be no blisters, wrinkles or loss of adhesion nor any general surface corrosion or pitting after 1000 hours of salt spray exposure.

Scribed: There shall be no blisters, wrinkles nor any general surface corrosion or pitting after 1000 hours of salt spray exposure. There shall be no more than 10mm loss of adhesion from a scribed line after 1000 hours of salt spray exposure.

Fluid Resistance Properties

The applied thermoplastic powder coatings shall exhibit no objectionable alteration to the surface such as discoloration, change in gloss, blistering, softening, loss of adhesion, formation of holidays or special phenomena after immersion for 7 Days in accordance with ASTM D 1308 in the following fluids.

1. Distilled water
2. Type III hydrocarbon (per Federal Spec. TT-S-735)
3. Hydraulic fluid (per Mil-H-83282)

Chemical Resistance

The applied thermoplastic coating shall exhibit no objectionable alteration to the surface such as discoloration, change in gloss, blistering, softening, loss of adhesion, formation of holidays or special phenomena after immersion for 7 Days in accordance with ASTM D 1308 in the following chemical solutions:

1. 3M aqueous CaCl_2 .
2. 3M aqueous NaOH .
3. Saturated aqueous $\text{Ca}(\text{OH})_2$.
4. Aqueous solution of H_2SO_4 (specific gravity = 1.29 60.02)

Dielectric Strength

The applied thermoplastic coating shall have a dielectric strength of 900 6100 v/mil at 15 mil in accordance with ASTM D 149.

Weathering Properties

The applied thermoplastic coating shall exhibit the following resistance to weathering:

1. **Accelerated weathering.** The applied thermoplastic powder coating shall show no cracking, significant color change (fade), chalking, Blistering, wrinkling or loss of adhesion, nor shall there be any evidence of substrate corrosion after 2000 hours exposure to accelerated weathering in accordance with ASTM G 53 using UVB-313 fluorescent lamps. The coating, shall exhibit no more than 30% loss in 60 degree specular gloss after exposure.
2. **Humidity resistance.** Test panels shall be exposed to a $120^\circ\text{F} \pm 2^\circ\text{F}$, 100% relative humidity environment in accordance with ASTM D 2247 for 30 Days. The coating shall show no blistering, wrinkling or loss of adhesion nor shall there be any evidence of substrate corrosion after humidity exposure.
3. **Holidays.** The applied thermoplastic powder coating shall be free of holidays at an application thickness of 25-30 mil. holiday detection shall be performed with a low voltage (75-100 volts) direct current detector.
4. **Shelf life.** Powder coating Materials shall meet the requirements of the Owner, with a minimum of 2 years from the date of manufacture when stored below 85°F , 50% relative in the unopened original container.

Material Safety Data Sheets (MSDS)

Material Safety Data Sheets shall be provided to the Engineer.

9-30.1(6)D POLYETHYLENE ENCASEMENT (FILM WRAP)

Plastic film wrap for polyethylene encasement shall be 8 mil polyethylene conforming to AWWA C105.

See Section 9-30.1(6)B for multi-layered polyethylene encasement.

9-30.1(6)E HEAT SHRINK JOINT SLEEVE

The sleeve shall be Aqua Shield, or approved equal. The sleeve shall be a wrap around type with a joint closure and shall contain a thermal indicator.

9-30.2 FITTINGS**9-30.2(1) DUCTILE IRON PIPE**

Fittings for ductile iron pipe shall be ductile iron conforming to AWWA C110, and AWWA C111 or AWWA C153 and shall be cement-mortar lined conforming to AWWA C104.

Except where restrained joint systems are required, fitting joints shall be mechanical joint.

Where restrained joint pipe is required, threaded flanges by restrained joint adapters shall not be longer than three pipe diameters. Threaded flanges and pipe shall conform to AWWA C115. The exterior flange lip overlapping the pipe barrel shall be sealed with a bituminous mastic.

Sleeves less than 12 inches in diameter shall be 12 inches minimum length and shall be mechanical joint.

Sleeves greater than 12 inches in diameter shall be of the long body type and shall be 15 inches minimum length and shall be mechanical joint.

Where ductile iron pipe is to be joined to existing cast iron pipe of the same nominal size, and electrical isolation is not required at the connection, and the outside diameter of the existing cast iron pipe varies 0.05 inches or less from the specified outside diameter of the ductile iron pipe being joined, the pipe shall be joined with a mechanical joint sleeve.

Where 10 inch through 24 inch diameter ductile iron pipe is to be joined to existing cast iron pipe of the same nominal size, and electrical isolation is not required at the connection, and the outside diameter of the existing cast iron pipe conforms to AWWA 1908 classifications A, B, C, or D, the pipe shall be joined with a transition mechanical joint sleeve having a single-piece body.

Where 8 inch or smaller diameter ductile iron pipe is to be joined to existing cast iron pipe of the same nominal size, and electrical isolation is not required at the connection, and the outside diameter of the existing cast iron pipe conforms to AWWA 1908 classifications A, B, C, D, E, or F, the pipe shall be joined with a transition mechanical joint sleeve having a single-piece body.

Hub-by-flange fitting length shall conform to AWWA C110 or AWWA C153. The body of hub-by-flange fittings shall be a single-piece casting. Threaded pipe and flange combinations shall not be used.

9-30.2(2) RESERVED**9-30.2(3) RESERVED****9-30.2(4) STEEL PIPE**

Fittings for steel pipe 3-1/2 inches in diameter and smaller shall be malleable iron threaded type with a pressure rating of 150 psi. Dimensions shall conform to ANSI B16.3. Threading shall conform to ANSI B2.1. Material shall conform to ASTM A 47, Grade 32510. All fittings shall be banded and hot-dip galvanized inside and out.

Unions shall be malleable iron with a pressure rating of at least 150 psi. Material shall conform to ASTM A 47, Grade 32510. Unions shall be ground joint, bronze to iron type.

Steel fittings for pipe 4 inches in diameter and larger shall be in accordance with AWWA C208. The class of the fittings shall be at least the same as that of the pipe. Coatings for the fittings shall be the same as specified for the pipe. Field couplings shall be compression type. When flanges are required, they shall conform to AWWA C207. All couplings shall have the same coating as the pipe coating.

9-30.2(5) RESERVED**9-30.2(6) RESTRAINED JOINTS**

Restrained joints, where required on the Drawings, shall be a boltless design which is flexible after assembly and can be disassembled without special tools, such as TR Flex Restrained Joint Pipe as manufactured by U.S. Pipe Co., or approved equal, and shall meet the following criteria;

1. The restrained joint shall have a positive metal to metal contact locking system without the use of gripping teeth.
2. The locking system shall allow the same joint deflection, after assembly, and shall weigh no more than twice the weight of
3. The TR Flex restraint system.
4. The joint restraint system for the pipe shall be the same as the joint restraint system for pipe fittings.

9-30.2(7) TRANSITION REDUCING, AND INSULATING FLEXIBLE COUPLINGS

Transition couplings, reducing couplings, transition reducing couplings, sleeves, and flexible insulating couplings for water mains shall be compression type, (Romac or Ford or approved equal, constructed of ductile iron sleeves, and ductile or malleable iron followers. Bolts and nuts shall be corrosion resistant per AWWA C111. Stainless steel bolts require anti-seize compound. Couplings shall be stainless steel. The long body pattern with a minimum length of 10 inches for pipe up to 12 inches diameter and 15 inches minimum length for pipe greater than 12 inches diameter. Factory finish shall be fusion bonded epoxy or Plascoat PPA 571 thermoplastic coating.

9-30.2(7)A INSULATING COUPLINGS

Insulating couplings and flange kits shall be required at any point of connection of two dissimilar metallic Material pipes (i.e., ductile iron to cast iron). The insulating coupling body and end rings shall be ductile iron; coated with either thermoplastic powder coating Plascoat PPA 571 fusion-bonded epoxy conforming to AWWA C213, or high-build polyamide

epoxy conforming to AWWA C210, and shall be a liquid coating, portable water grade, capable of 4 to 8 mil dry film thickness per coat, or thermoplastic powder coat per section 9-30.1(6)C; insulating boot shall cover the pipe end to prevent metal contact between pipe sections being joined. The insulating boots and rubber gaskets shall be virgin synthetic butyl rubber compatible for potable water service. The nuts and bolts shall be stainless steel ASTM Type 316. The insulating coupling shall be manufactured by Romac Industries, Inc., or approved equal.

9-30.2(7)B INSULATING FLANGE KITS

Insulating flange kits shall consist of a full-face neoprene faced phenolic, type "E" O-ring gasket; insulating sleeves and washers manufactured from glass reinforced epoxy design; and 1/8 inch thick plated, hot rolled steel washers. Acceptable Suppliers are Pipeline Seal and Insulator (PSI) Inc., Houston, Tx.; Central Plastics Co., Shawnee, OK.; or approved equal.

9-30.2(8) RESTRAINED FLEXIBLE COUPLINGS AND SLEEVES

Restrained flexible couplings or sleeves shall be as indicated on the Drawings.

9-30.2(9) SPECIAL FITTINGS

Special fittings shall be as indicated on the Drawings.

9-30.2(10) TWO-INCH BLOWOFF ASSEMBLY

Two inch blowoff assembly shall be as indicated on Standard Plan nos. 340a and 340b at the locations shown on the Drawings.

Two inch service tube shall be Type K copper. Two inch gate valve shall be of iron-body construction, having bronze seat rings and stem, an o-ring stem seal system, shall be fitted with a 2 inch square operating nut, F.I.P.T. inlet and outlet threading conforming to ANSI B2.1, and shall be minimum 150 pounds working water pressure rated. Plastic foam Material shall conform to Section 9-30.2(11). Frame and cover shall conform to Section 9-30.3(12)H. Meter Box shall conform with Section 9-30.6(8).

9-30.2(11) PLASTIC FOAM (ETHAFOAM)

Plastic foam shall be in accordance with Section 9-05.14

9-30.2(12) PORTLAND CEMENT CONCRETE

Portland Cement Concrete for pipe support saddles and cradles and for thrust blocking shall be Class 5 (1-1/2) (see Section 5-05.3).

9-30.2(13) RESERVED

9-30.2(14) STEEL CASING PIPE

Steel casing pipe shall have a diameter and wall thickness as specified on the Drawings. Pipe shall be smooth and bare.

9-30.2(15) SEALS AND INSULATORS FOR STEEL CASING PIPE

Casing insulators shall be used to electrically isolate the casing pipe from the water main. The insulators shall be equipped with heavy duty fusion bonded epoxy coated stainless steel spacers, minimum 12 inch width, 2" wide glass reinforced plastic runners. A minimum of (2) runners at the bottom and (2) top runners for pipe 4" through 12". A minimum of (4) runners at bottom and (2) top runners for 14" through 36" pipe. The insulators shall be Pipeline Seal and Insulator (PSI) model C12G-2 as manufactured by Pipeline Seal and Insulator, Inc., or approved equal.

Casing end seals shall be used to seal the ends of the casing with the water main. The seals shall be standard pull-on, model S or custom pull-on, model C as manufactured by Pipeline Seal and Insulator, Inc., or approved equal.

9-30.3 VALVES

9-30.3(1) GENERAL - MANUFACTURE AND MARKING

The valves shall be a standard pattern of a manufacturer whose products are approved by the Engineer and shall have the name or mark of the manufacturer, year valve casting was made, size, and working pressure plainly cast in raised and legible letters on the valve body. All valves shall be stamped with "NSF APPROVED".

9-30.3(2) GATE VALVES

9-30.3(2)A GATE VALVES - DOUBLE DISC

In addition to 9-30.3(1), gate valves 3 inch through 12 inch shall conform to AWWA C500, be equipped with non-rising stems and "O" ring stuffing box, and with double disc gates having a bronze wedging device.

All gate valves shall have a ductile iron body.

Valves shall open counterclockwise when viewed from above, and shall be equipped with a standard AWWA 2 inch square operating nut. Valves shall be double disc-bronze seated valves if they have iron bodies.

Three Manufacturer's Certificates of Compliance demonstrating performance tests comply with AWWA C500 shall be submitted to the Engineer.

Valve ends shall be mechanical joint. Where restrained joints are called out, valve ends shall be flanged with appropriate flange by restrained joint adapters per Section 9-30.2(1).

The valves shall be as manufactured by Clow, M & H, American Flow Control (ACIPCo), Pratt/Mueller, M&H/Kennedy, or approved equal in sizes 12 inches or less.

Gate valves 2-1/2 inch and smaller shall be of ductile iron body construction having bronze seat rings and stem, o-ring seal system, F.I.P.T. (female iron pipe thread) inlet and outlet conforming to ANSI B2.1, a standard AWWA 2 inch operating nut, and shall be minimum 150 pounds water working pressure.

The 2 inch and smaller valves shall be manufactured by Kennedy, Nibco-Scott, Stokum, or approved equal.

9-30.3(2)B GATE VALVES RESILIENT SEAT

Gate valves 3 inch through 12 inch shall conform to AWWA C509 and Section 9-30.3(1).

9-30.3(3) RESERVED

9-30.3(4) BUTTERFLY VALVES

In addition to the requirements of section 9-30.3(1), *Water Main* butterfly valves shall conform to AWWA C504 and shall be Class 150B. The valve shall be short-body type and shall have flanged ends. Flanged ends shall be sized and drilled in conformance with ANSI B16.1 Class 125. Valve shall be suitable for direct burial installation; however butterfly valves 12 inch and larger shall be installed within an access vault sized to permit removal and replacement of the valve.

All butterfly valve bodies shall be ductile iron.

Butterfly valves other than AWWA C504 Class 150 and butterfly valves installed on water transmission pipeline shall be as indicated in the Contract.

Where butterfly valves are installed on restrained joint Water Mains, the valve ends shall be flanged with flanged by restrained joint adapters per Section 9-30.2(1).

Valves shall be mounted on the water main or pipeline such that the operating nut is accessible and operable from above.

Operator shall be manual, fully enclosed, and suitable for buried service. It shall open left (counterclockwise when viewed from above), and shall be equipped with a standard AWWA 2 inch square operating nut.

Operators for 16 inch and larger valves shall be equipped with external indicators, visible from above, which show the position of the valve disc.

Unless otherwise indicated in the Contract, the minimum number of turns from fully open to fully closed on Class 150 butterfly valves shall be as follows:

Diameter	Turns, min.
4 inch to 8 inch	16 turns
10 inch to 12 inch	28 turns
14 inch to 18 inch	30 turns
20 inch	60 turns
24 inch	100 turns
30 inch	150 turns
36 inch and larger	200 turns

A Manufacturer's Certificate of Compliance stating that the valves to be furnished fully comply with AWWA C504 and the modifications contained herein shall be submitted to the Engineer before incorporation of the valve into the Work.

Valves shall be connected to Water Main with non-corrosive bolts and nuts. Wearing surfaces shall be bronze or other approved noncorrosive Material and there shall be no moving bearing or contact surface of iron in contact with iron. Contact surfaces shall be machined and finished in the best workmanlike manner, and all wearing surfaces shall be easily renewable.

The butterfly valves shall be manufactured by Henry Pratt Company, Mueller, M&H/Kennedy Valve Division of McWane Inc., or approved equal.

The valve manufacturer shall provide a non-corrosive durable metal tag, measuring 4 inches by 6 inches, or other size as approved by the Engineer, with the number of turns to fully open/close the valve permanently stamped on the tag. A non-corrosive high strength durable cord, approximately 18 inches in length, shall permanently attach the tag to either the bottom end of the valve box or the lower section of the valve chamber frame, as applicable.

9-30.3(5) VALVE BOXES

Valve boxes shall be installed on all buried valves. The box and lid shall be cast iron, 2-piece slip type with cast iron extension as necessary, conforming to requirements and dimensions of the current Seattle Public Utilities - Water Utility Standards.

The cover shall have the word "WATER" or the letter "W" cast in it.

Valve boxes, lids and extensions of the following manufacture and pattern are approved for use:

Olympic Foundry (1984) Inc.

Lid Section # 1908-33

Top Section # 1106-33

Base Section # 1301-33

Top Section and Lid #045 with Rich standard base and extension.

Each top and lid section shall be tested for accuracy of fit and shall be marked in sets for delivery.

Valve box extension pieces shall be provided for valves with ground cover in excess of the depth of the standard valve box (see Standard Plan nos. 315a and 315b).

9-30.3(6) RESERVED

9-30.3(7) COMBINATION AIR RELEASE / AIR VACUUM VALVES

Combination air release/air vacuum valves shall comply with the requirements of ANSI / AWWA C512.

9-30.3(8) END CONNECTIONS

The dimensions of hub or bell end connections shall conform to the dimensions of AWWA C100. The dimensions for the mechanical joint connections shall conform to the ANSI A21.11.

The end flanges of flanged valves shall conform in dimensions and drilling to the standard ANSI B16.1 for cast iron flanges and flanged fittings, Class 125, unless specifically provided otherwise *in the Contract*. The bolt holes shall straddle the vertical center line.

9-30.3(9) RESERVED

9-30.3(10) OPERATING NUT EXTENSIONS

An operating nut extension conforming to Standard Plan no. 315b shall be furnished and installed by the Contractor on all valves where the finished grade is more than 30 inches above the valve operating nut.

9-30.3(11) PLASTIC FOAM RINGS

Valve boxes shall have a 2 inch thick plastic foam cushion installed between the base flange of the valve box bottom section ring conforming to the dimensions shown on Standard Plan no. 315b installed between the base and the valve casting. *The plastic foam shall conform to the requirements of Section 9-05.14.*

9-30.3(12) VALVE CHAMBERS

9-30.3(12)A PRECAST VALVE CHAMBER

Size, shape, and Materials shall be as indicated on the Drawings.

The chambers shall be furnished in precast concrete sections with sufficient strength to withstand H 20 *Traffic* loading together with ladder and access frames and covers to provide the minimum clearance dimensions shown on the Drawings.

The chambers shall be watertight after assembly. Gasket Material shall be installed in the groove of the keyway of each chamber section as it is installed. There shall be no evidence of moisture seeping into the chambers through the walls, floor, or joints.

9-30.3(12)B CONCRETE BLOCKS FOR VALVE CHAMBERS

Portland cement concrete blocks shall be solid, and shall conform to the requirements of ASTM C139. Overall thickness of block shall be 6 inches with optional lengths and widths. Curved manhole blocks shall be used for round valve chambers.

9-30.3(12)C CONCRETE BRICK FOR VALVE CHAMBERS

Concrete brick shall be solid and conform to ASTM C55, Grade A.

9-30.3(12)D CLAY BRICK FOR VALVE CHAMBERS

Clay brick shall conform to ASTM C62, Grade SW.

9-30.3(12)E MORTAR

Portland cement mortar shall be 1 part Portland cement to not less than 1-1/2 parts nor more than 3 parts of plaster sand, mixed with the least amount of water necessary to provide a workable mix. Dehydrated lime, in an amount not exceeding 50 percent of the Portland cement by weight, may be added to the mix at the option of the Contractor.

9-30.3(12)F PORTLAND CEMENT CONCRETE

Concrete for chamber foundation shall be Class C (see Section 6-02.3).

9-30.3(12)G CAST-IN-PLACE CONCRETE VALVE CHAMBER

The design, size, shape, and Materials for cast-in-place concrete valve chambers shall be in accordance with the Drawings. *The Contractor shall submit Shop Drawings of the chamber indicating all features to the Engineer per Section 1-05.3.*

9-30.3(12)H FRAME AND COVER AND VALVE BOX CASTINGS

Castings for cast iron frame and cover and for cast iron parts of valve boxes shall conform to the requirements of ASTM A 48, Class 30 and shall conform to the Standard Plans unless specified otherwise in the Contract.

The word "WATER" shall be cast in the cover in 3 inch letters as indicated on the Standard Plans.

Each ring and cover section shall be tested for accuracy of fit and shall be marked in sets for delivery.

An acceptable Supplier is Olympic Foundry Type SM29 standard box and lid or approved equal.

See Section 9-30.3(4) regarding the permanent connection of the tag, indicating the number of turns to fully open/close the butterfly valve, to the valve box or to the valve chamber.

9-30.3(12)I MORTAR FOR PLASTER-COATING

Mortar for plaster-coating masonry unit manholes shall be proportioned according to either of the two following tabulated alternates:

	Parts by volume Portland cement	Parts by volume masonry cement	Parts by volume hydrated lime or lime putty
alternate 1	1	1 (Type II)	0
alternate 2	1	0	1/4

Plaster sand for either alternate 1 or alternate 2 above shall be measured in a damp, loose condition, and shall be not less than 2-1/4 and not more than 3 times the sum of volumes of cement and lime.

A bituminous coating shall be applied to all surfaces after plastering.

9-30.3(12)J LADDERS

Ladder shall be made of steel, and shall be galvanized after fabrication. They shall be made of 1 inch deformed steel bar conforming to ASTM A 615, intermediate or standard grade, hot bent at least 1600°F. Galvanization shall conform to ASTM A 123.

9-30.3(13) PAINTING AT FACTORY

After the factory test and inspection, all ferrous parts of the valves except finished or bearing surfaces shall be painted inside and out with two coats of asphalt varnish, Federal Specification TT-V-51A or approved equal.

9-30.3(14) WATER PRESSURE REGULATING VALVES

1. Water Pressure Regulating Valves, 3 inch through 12 inch Sizes:

Valve shall be flanged at both ends, Class 125 ASA drilling, with cast iron body. Valve shall be a diaphragm operated, single seat, globe valve *with stainless steel trim*. It shall be spring loaded and hydraulically operated. Seat ring shall be replaceable. The diaphragm shall be fully guided top and bottom. All necessary repairs shall be possible without removing the valve from the line. Packing glands are not permitted. Disc shall be synthetic rubber and have a rectangular cross section. The stem shall be guided by a bearing in the valve cover and an integral bearing in the valve seat. There shall be no piston operating the main valve.

Valves shall be designed to maintain a constant downstream pressure regardless of varying inlet pressure. They are to be used in handling clean, cold water.

No control pilots or optional Equipment is to be furnished. Valves shall be CLA Valve No. 90 or approved equal.

2. Water Pressure Regulating Valves, 2 inch Size:

Valves shall be Mueller No. H-9310 2 inch Water Pressure Reducing Valves or approved equal.

9-30.3(15) COATINGS FOR VALVES

Special coatings, thermoplastic powder coating, and polyethylene encasement shall be per Section 9-30.1(6)D.

9-30.4 RESERVED

9-30.5 HYDRANTS

9-30.5(1) GENERAL

Fire hydrants shall conform to AWWA C502 and shall be of standard manufacture and of a pattern approved by SPU Water Operations. The name or mark of the manufacturer, size of the valve opening and year made shall be plainly cast in raised letters on the hydrant barrel to be visible after the hydrant is installed.

Hydrants of the following manufacture and pattern have been approved for use by the City of Seattle:

1. Pacific States
2. Clow Model 5110 (Iowa)
3. Mueller "Centurion" Model A-423
4. American-Darling Model B-62B
5. Kennedy "Guardian"

9-30.5(2) END CONNECTIONS

The end connection shall be 6 inches, standard flange, Class 125 drilling conforming to ANSI B16.1.

9-30.5(3) HYDRANT DIMENSIONS

The dimensions and details of hydrant and nozzles shall be as follows:

1. Hydrant connection pipe size inside diameter: 6 inches.
2. Standpipe, minimum inside diameter: 7 inches.
3. Valve opening, minimum diameter: 5 inches.

4. Size of auxiliary gate valve: 6 inches.
5. Hose nozzles, number and size: two 2-1/2 inches.
6. Thread (National Board of Fire Underwriters): 7-1/2 per inch.
7. Total length of threaded male nipple: 1 inch.
8. Streamer nozzle, number and size: one 4 inch.
9. Hydrants shall be furnished with one pumper nozzle with size and threads conforming to dimensions as identified on the current City of Seattle Standard Plans for Fire Hydrants.
10. Drain Valve: Drain valve shall be automatic with outlet tapped or plumbed to 3/4 inch female iron pipe threads.
11. Sidewalk flange (ring) to center of pumper nozzle: 14 inches or more.
12. Face: Pumper port toward the street.

All nozzles shall be fitted with cast iron threaded caps with operating nut of the same design and proportions as the hydrant stem nut. Caps shall be threaded to fit the corresponding nozzles and shall be fitted with suitable neoprene gaskets for positive water tightness under test pressures.

9-30.5(4) OPERATING NUTS

The operating nuts on hydrant stem and nozzle caps shall be as follows:

Pattern of nut	Tapered pentagonal
Height	1-1/6 inch
Size of pentagon	1.35 inch at bottom of nut
	1.23 inch at top of nut (measured from point to flat)

The direction of opening shall be clearly marked on the operating nut or hydrant and shall be counterclockwise.

9-30.5(5) HYDRANT RESTRAINT

Shackling rods shall be 3/4 inch diameter with threaded ends, and shall meet ASTM A 36. "All-thread" rod is not acceptable. If a tie bolt restraint system is used, they shall be "COR-TEN Steel Star National Products Super Star Tie Bolt #SST7" or approved equal. If a mechanical joint- gland-with-lugs restraint system is used, it shall conform dimensionally as shown on the hydrant detail, and shall be ductile iron conforming to ASTM A 536 Class 80-55-06. Coating for shackling rods shall be in accordance with Section 9-30.15.

9-30.5(6) SIDEWALK FLANGE CONSTRUCTION

Hydrants shall be provided with a sidewalk flange and be equipped with breaking devices at the sidewalk flange which allow the hydrant barrel to separate at this point with a minimum breakage of hydrant parts in case of damage. There shall also be provided at this point, a safety stem coupling on the operating stem that shears at the time of impact. Unless otherwise specified *in the Contract*, all hydrants shall be equipped with 0-ring stem seals.

9-30.5(7) HYDRANT PAINTING

9-30.5(7)A HYDRANT SHOP PAINTING

All iron parts of the hydrant shall be thoroughly cleaned and painted at the factory. All inside surfaces and the outside surfaces below the ground line shall be coated with asphalt varnish, Federal Specification TT-V-51a or J.A.N.P-450, unless otherwise specified *in the Contract*. They shall be covered with two coats, the first having dried thoroughly before the second is applied.

9-30.5(7)B HYDRANT FIELD TOUCH-UP PAINTING

All iron parts of the hydrant shall be thoroughly cleaned and painted at the factory. All inside surfaces and the outside surfaces below the sidewalk flanges shall be coated with asphalt varnish, Federal Specification TT-V-51a or J.A.N.P-450, unless otherwise specified *in the Contract*. They shall be covered with two coats, the first having dried thoroughly before the second is applied.

The hydrant curb stand section, including all exposed surfaces of the sidewalk flange, shall receive two coats of oil based gloss enamel paint (Kelly-Moore Luxlite or approve equal) in Caterpillar yellow. Based on the elevation of the hydrant within the surrounding pressure zone, if the maximum static pressure at the hydrant is less than 60 psi, the engine port cap on the hydrant shall be painted with two coats of oil based gloss enamel paint (Kelly-Moore Luxlite or approve equal) with the final coat being Red.

9-30.5(8) HYDRANT FACTORY HYDROSTATIC TEST

All hydrants shall be tested by the manufacturer, as required in AWWA C502. The Contractors shall furnish to the Owner an affidavit of compliance from the manufacturer for all tests.

9-30.5(9) HYDRANT CONNECTION PIPE

Pipe connections from the hydrant to the Water Main shall be 6 inch Ductile Iron Pipe, Class 52, in accordance with Section 9-30.1(1).

9-30.5(10) HYDRANT VERTICAL EXTENSIONS

Hydrant barrel extensions shall have a 7 inch minimum inside diameter and shall be gray cast iron or Ductile Iron and shall conform to the AWWA Standards for such castings. The drillings of the connecting flanges on the extensions shall match the drillings of the flanges on the hydrant.

Hydrant vertical extensions shall also include the necessary hydrant operating stem extension, complete with safety stem couplings.

Extensions with threaded flanges shall be ductile iron and shall conform to AWWA C115. The exterior flange lip overlapping the barrel pipe shall be sealed with a bituminous mastic.

Vertical extensions shorter than 18 inches shall be installed at the bottom of the factory supplied barrel pipe.

9-30.5(11) HYDRANT BLEEDER

The hydrant bleeder assembly, as shown on the hydrant detail, shall be constructed of 3/4 inch copper tubing Type K, conforming to Section 9-30.6(4).

9-30.5(12) POLYETHYLENE ENCASEMENT AND SPECIAL TAPE COATING FOR HYDRANTS AND CONNECTIONS

Refer to Section 9-30.1(6).

9-30.6 SERVICE CONNECTIONS AND SERVICE PIPE OR TUBING**9-30.6(1) GENERAL**

Service piping standards shall be used, and modified when indicated on the Drawings, for 2 inch blowoff assembly and hydrant bleeder assembly.

9-30.6(2) SADDLES

Saddles shall be ductile iron, or bronze, double straps with thread standard outlet tapping. Saddles shall be of a size designed by the manufacturer to fit the pipe called for on the Drawings.

9-30.6(3) CORPORATION STOPS

Corporation stops for use with saddle shall be of bronze alloy with inlet M.I.P. (male iron pipe) standard thread and outlet thread compatible with connection piping, with no special adapters. Corporation stops for direct tapping shall be bronze alloy with AWWA tapered inlet Outlets on 3/4 inch and 1 inch direct tap corporation stops shall be copper tubing size compression, with an external clamping or anti-pullout feature. Outlets on 1-1/2 inch and 2 inch direct tap corporation stops shall be male iron pipe or tubing to be connected.

9-30.6(4) SERVICE PIPE**9-30.6(4)A COPPER TUBING**

Copper tubing shall conform to the requirements of ASTM B 88, Type K, annealed. The tubing shall be coupled using compression fittings having a positive external gripping feature to prevent tubing pull-out, conforming to the requirements of AWWA C800, minimum 150 psi working pressure.

9-30.6(5) COMPRESSION COUPLINGS

Compression couplings for use in connecting plain end water service pipes shall be applicable for the type of pipe being coupled. Compression couplings shall have armored gaskets when similar metal pipes are being joined.

9-30.6(6) RESERVED**9-30.6(7) METER STOPS AND SETTERS**

Meter stops and setters shall be in accordance with the SPU Water Operation Standards.

9-30.6(8) METER BOX AND LID

Meter Box and Lid shall be in accordance with the current SPU Water Operation Standards. The Meter Box casting shall conform to ASTM A 48, Class 30 for gray cast iron. The Lid casting shall conform to ASTM A 536, Grade 80-55-06 for ductile iron. Castings shall be brushed or dipped with a bituminous coating. Meter Box and Lid shall be Olympic Foundry (1984) Inc. SM-29, or approved equal.

9-30.6(9) VALVES

Valves shall conform to Section 9-30.3.

9-30.7 BEDDING, FOUNDATION MATERIAL AND GRAVEL

When the Mineral Aggregate is specified by a "Type" designation, it shall conform to the requirements in Section 9-03. See Section 7-10.3(9) for bedding requirements.

9-30.8 RESERVED**9-30.9 RESERVED**

9-30.10 JOINT BOND CABLE

General joint bond cable shall be single-conductor No. 2 AWG stranded copper wire with 600-volt, 7/64" thick high molecular weight polyethylene (HMWPE) insulation. Supply all joint bonds complete with a formed copper sleeve on each end of the wire, as specified under THERMITE WELD MATERIALS, this Section.

9-30.11 THERMITE WELD MATERIALS**9-30.11(1) GENERAL**

Thermite weld Materials shall consist of wire adapter sleeves, welders, and weld cartridges according to the weld manufacturer's recommendations for each wire size and pipe or fitting size and Material. All welding Materials and Equipment shall be the product of a single manufacturer. Interchanging Materials of different manufacturers will not be acceptable.

Molds shall be made of graphite. Ceramic "one-shot" molds will not be acceptable.

Steel thermite weld cartridges shall be used for steel pipe and fittings. Cast iron thermite weld cartridges shall be used for all cast and ductile iron pipe and fittings. Maximum cartridge sizes for steel thermite welds shall be: 15 grams for wire sizes #14 AWG through #4 AWG stranded, and 32 grams for #2 AWG stranded.

Maximum sizes for cast iron thermite welds shall be: 25 grams for #14 AWG through #6 AWG stranded, and 45 grams for #4 AWG solid through #2 AWG stranded.

Thermite weld Material may be obtained from the following Suppliers: Erico Products Inc. (Cadweld), Cleveland, Ohio; or Continental Industries, Inc. (Thermoweld), Tulsa, Oklahoma; or approved equal.

9-30.11(2) ADAPTER SLEEVES

Provide Adapter Sleeves for all No. 12 AWG through No. 2 AWG test station and joint bond wire. Prefabricated factory sleeve joint bonds or bond wires with formed sleeves made in the field are acceptable. Field-formed joint bond sleeves shall be attached with the appropriate size and type of hammer die provided by the thermite weld manufacturer.

9-30.11(3) THERMITE WELD CAPS AND PRIMER

Thermite Weld caps shall be prefabricated weld caps with coating and suitable primer, such as Handy Cap II with Royston Primer 707, as manufactured by Royston Laboratories, Inc., or equal.

9-30.11(4) COATING REPAIR AT THERMITE WELD

Repair of coating of pipe and fittings for spot damage at thermite weld connections not included in standard pipeline coating repair procedure, shall be 100% solid epoxy that cures in submerged or buried conditions. Repair of thermoplastic powder coating shall be as specified in Section 9-30.1(6)C6.

9-30.12 ELECTROLYSIS TEST STATION**9-30.12(1) GENERAL - NON-TRAFFIC AREA**

An electrolysis test station shall consist of a standard meter box and lid as specified in Section 9-30(6)8 providing a housing for a test box as specified in Section 9-30.12(2).

9-30.12(2) TEST BOX

Test box requirements shall be as follows:

The 4" (10 cm) deep test box shall provide a single piece enclosure 8" by 6" (20 cm by 15 cm) with a removable, hinged lid. The test box shall be Hoffman No. 864CHQRFQ or approved equal.

The lid shall be manufactured from molded fiberglass reinforced Material, and fitted with a one-piece oil resistant "O" ring gasket. The lid shall be attached to the test box with a monel hinge pin and secured by quick release latches.

The test box shall comply with NEMA 4X standards, to supply protection against corrosion, windblown dust, rain, splashing water, and hose direct water.

A watertight connector consisting of a heat-shrinkable cable entry system, shall be used for passage of test wires into the enclosure. The entry system shall be a three part assembly consisting of a rigid plastic nut, a rubber O-ring, and molded heat-shrinkable cable entry seal including tape sealant. The cable entry system shall be type CES-2 or CES-3, with SFTS-1 or SFES-3 tape sealant as manufactured by Sigmaform Corporation; or approved equal.

9-30.12(3) TEST STATION WIRES

Test station wires shall be single conductor, No. 10 AWG and No. 6 AWG stranded copper with 600 volt XHHW insulation. Color of insulation per Drawings.

9-30.12(4) WIRE CONNECTORS INSIDE TEST BOX

Wire connectors inside the test box shall be one-piece, tin-plated crimp-on lug connector as manufactured by Burndy Co., Thomas and Betts, or equal.

9-30.12(5) ZINC REFERENCE ELECTRODES

The electrode shall be packaged in a thoroughly mixed backfill material consisting of 75% gypsum, 20% bentonite clay and 5% sodium sulfate. The package shall be water permeable and of sufficient size to ensure complete envelopment of the reference electrode.

9-30.12(6) ELECTRICAL CONDUIT AND FITTINGS

PVC electrical conduit and fittings shall be schedule 40 and UL listed for direct burial. Conduit and fittings shall meet the requirements of NEMA TC and TC3, federal specification W-C-1094, UL and NEC.

9-30.13 TURBINE METERS (METER, COLD WATER, MAGNETIC DRIVE TURBINE TYPE, SIZES 2" - 12")**9-30.13(1) GENERAL**

These requirements apply to Magnetic Drive Turbine Type Cold Water Meters 2 inch through 12 inch in size, manufactured for use on customer water services. Turbine Meters shall consist of a cast bronze case containing the measuring mechanism with a strainer housing attached.

Meters shall meet the requirements of *AWWA C701, current edition*, Class II type, except as modified herein.

9-30.13(2) REGISTER AND REGISTER BOX

Registration shall be in cubic feet.

9-30.13(3) RESERVED**9-30.13(4) MEASURING MECHANISM**

The measuring mechanism shall be the inline type, and so designed that it can be readily removed from the main case as a complete unit. The measuring mechanism shall be capable of operating within the accuracy limits specified under "Normal Flow Limits" in Section 9-30.13(7) without recalibration when transferred from one turbine meter case to another.

9-30.13(5) INTERMEDIATE GEAR TRAIN

If an intermediate gear train is utilized, it shall operate in a dry, hermetically sealed compartment, separated from the water passage by a bronze wall.

9-30.13(6) CAPACITY AND ACCURACY

The turbine meter shall register all rates of flow through it with an accuracy of $100\% \pm 2\%$ at rates of flow within the limits specified under "Normal Flow Limits" in Section 9-30.13(7).

9-30.13(7) NORMAL FLOW LIMITS

Size	Normal Flow Limit
2-Inch	5 - 160 GPM
3-Inch	10 - 350 GPM
4-Inch	15 - 800 GPM
6-Inch	30 - 1800 GPM
8-Inch	50 - 3500 GPM
10-Inch	55 - 5500 GPM
12-Inch	70 - 7000 GPM

NOTE: Above flow limit shall be for continuous flows, all turbine meters shall have a 25% overspeed capacity for intermittent flows.

9-30.13(8) HEAD LOSS

Maximum loss of head shall not exceed 7 psi at the flow rates listed under "Normal Flow Limits" in Section 9-30.13(7).

9-30.13(9) CONNECTIONS

All main case connections shall be flanged. The flanges for 2 inch meters shall be of the two bolt oval type. Meters shall be furnished without companion flanges.

9-30.13(10) INTERCHANGEABLE PARTS

All parts of turbine meters of the same size, make and model shall be interchangeable.

9-30.13(11) STRAINER

Turbine meters shall be supplied with a strainer attached. Strainers shall be short pattern, 125 lb. ANSI, iron body, with heavy gauge 1/4 inch perforated, stainless steel screen having an effective straining area at least double that of the meter main case inlet.

9-30.13(12) REMOTE READING

Turbine meters shall be compatible with existing SPU Automated Meter Reading and Demand Recording Hardware and/or switches. Manufacturer, type, and style of switch shall be submitted for approval by the Engineer before ordering.

9-30.13(13) MANUFACTURE AND APPROVAL

Only meters manufactured by a well established firm will be considered. Only those meters of a specific model and manufacturer, samples of which have been submitted to *SPU Water Meter Shop* for inspection and approval, and carrying a minimum 1 year guarantee will be acceptable.

9-30.13(14) INSPECTION

All turbine meters purchased under this Specification will be subject to inspection and testing by SPU Water Meter Shop upon receipt, and if any meter is found not to conform with these Specifications, the lot or any portion thereof may be rejected.

9-30.13(15) GUARANTEE

All turbine meters shall be guaranteed for a period of 1 year after installation. This guarantee shall be against defects in Materials, workmanship, and construction.

9-30.13(16) TEST REPORT

All turbine meters purchased under this Specification shall be accompanied by a notarized test report of the factory accuracy test.

9-30.14 LOCATING WIRE

Locating wire shall be 14 gauge solid copper with neoprene coating. Connections and splices shall be made with Penn Wilson split Bolt Wire Connectors, catalog No. 5-8-5, or approved equal.

9-30.15 COATING FOR ALL BOLTS AND SHACKLE RODS

All bolts and shackle rods shall be coated with 2 coats of asphaltic varnish Royston Roskote 612 XM, or approved equal.

On corrosion protected Water Mains, all shackle rods, concrete blocking anchor rods, and shackle clamps shall have a factory applied protective coating with fusion bonded epoxy in accordance with ASTM A 755. After threading and assembly, the threaded ends, nuts, and washers shall be coated with a wrapping of Trenton wax tape #1 or approved equal.

9-30.16 BACKFLOW PREVENTION DEVICES (BPDs)**9-30.16(1) GENERAL**

All backflow prevention devices shall be on the Washington State Department of Health current list of approved backflow prevention devices, and both temporary and permanent installations of such devices shall be verified acceptable by the Engineer.

All backflow prevention devices, whether temporary or permanent, are subject to inspection by SPU Inspection Services before connection with any Water Main. See Section 1-07.28 item 5D regarding BPD inspection notification requirements. After initial inspection and acceptance, annual testing is required.

Backflow prevention devices installed on premises, or not installed for premise isolation purposes, shall be inspected by Seattle King County Health Department Plumbing Inspection.

9-30.16(2) ATMOSPHERIC VACUUM BREAKERS (AVBs)

Atmospheric vacuum breakers shall be of a type included in the Washington State Department of Health current listing of "Acceptable Atmospheric (Non-Pressure) Type Vacuum Breaker" or other types with IAPMO approval. AVBs shall be installed downstream of the last shutoff valve and a minimum of 6 inches above the highest outlet or overflow level of the irrigation system. AVBs shall be installed above ground.

An atmospheric vacuum breaker shall be attached to each hose bib. An AVB shall not be operated for more than 12 hours in any 24 hour period. AVBs shall not be used on systems with chemical additions.

9-30.16(3) PRESSURE VACUUM BREAKER ASSEMBLIES (PVBAs)

Pressure vacuum breakers shall be of a type included in the Washington State Department of Health current listing of "Acceptable Pressure Type Vacuum Breaker" or other types with IAPMO or USC approval. PVBAs shall be installed a minimum of 12 inches above the highest outlet or overflow level of the irrigation system and located so that adequate room is available for maintenance and testing. PVBAs shall be inspected and tested annually during the life of the Contract by backflow device testers certified by the Washington State Department of Health. PVBAs shall not be installed below ground. PVBAs shall not be used for systems with chemical additions.

9-30.16(4) DOUBLE CHECK VALVE ASSEMBLIES (DCVAs)

Double check valve assemblies shall be of a type included in the Washington State Department of Health current listing of "Approved Double Check Valve Assemblies".

Installations shall be according to procedures outlined in the current edition of "Accepted Procedure and Practice in Cross-Connection Control Manual" published by the Pacific Northwest Section, American Water Works Association. DCVAs shall be inspected and tested annually during the life of the Contract by backflow device testers certified by the Washington State Department of Health.

DCVAs can be installed below ground only if enclosed in an approved irrigation vault, chamber, or other approved enclosure. DCVAs shall not be used for systems with chemical additions.

9-30.16(5) REDUCED PRESSURE PRINCIPLE BACKFLOW PREVENTION DEVICES (RPBDs)

Reduced pressure principle backflow prevention devices will be required for any system using chemical additions or proposed to use chemical additions. Such systems include irrigation systems with fertilizer or other chemical addition. These units shall be of a type included in the Washington State Department of Health current listing of "Approved Reduced Pressure Backflow Devices". Inspection of the installation, to insure proper operation, will be conducted by SPU Inspection Services.

RPBDs shall be inspected and tested annually during the life of the Contract by backflow device testers certified by the Washington State Department of Health.

Installation shall be according to procedures outlined in the current edition of "Accepted Procedure and Practice in Cross-Connection Control Manual" published by the Pacific Northwest Section, American Water Works Association.

RPBDs shall not be installed below ground.

9-30.16(6) RESERVED

SECTION 9-31 ILLUMINATION AND ELECTRICAL MATERIALS

9-31.1 LUMINAIRES

9-31.1(1) GENERAL

Luminaires shall have attached to the housing, an ANSI approval decal (3 inches square) which shall be readily visible from the ground, indicating lamp type by color code (i.e., blue for Mercury Vapor, gold for High Pressure Sodium, red for Metal Halide); and lamp wattage by numerical code, i.e.:

Numerical Code	Lamp Wattage
15	150 Watt
25	250 Watt
40	400 Watt

Legends shall be a minimum of 2 inches in height and weather resistant.

The Contractor shall be prepared to provide a sample luminaire for testing when requested by the Engineer.

9-31.1(2) ROADWAY LIGHTING LUMINAIRE

Luminaires shall be "cobrahead" style and shall consist of a luminaire housing, lamp, ballast, and photoelectric cell. Luminaires shall be in accordance with SCL Material Standard 5723.1 except as modified herein.

Luminaire light distribution patterns shall conform to the IES classification system for Type III medium cutoff for less than 200 watts and Type II short cutoff for 200 watts and more.

Glare control shall be accomplished by use of a flat lens. Minimum streetside utilization shall be 39 percent at 1.5 transverse mounting height. Distribution shall be free from striations and hotspots.

9-31.1(3) LAMPS

High pressure sodium lamps shall be clear lamps suitable for operation in any position meet the following minimum ratings:

Wattage	Minimum Life (Hours)	Initial Lumen Output
150	24,000	16,000
250	24,000	28,800
400	24,000	50,000

9-31.1(4) RESERVED

9-31.1(5) PHOTOELECTRIC CELLS

Photoelectric controls shall be used with all luminaires and shall meet the requirements of SCL Material Standard 5693.0.

9-31.1(6) UNDERDECK MOUNTED UNDERCROSSING LUMINAIRE

Underdeck luminaire shall be pendant-mounted as called for on the Drawings. The ballast shall be integral with the luminaire. Ballast housing and structural parts shall be of cast aluminum. Mounting devices *shall* provide positive, vibration-proof locking. Luminaires shall be UL listed as "Enclosed and Gasketed" and shall be suitable for wet locations. All exposed screws and/or rivets shall be of stainless-steel Material.

All exposed cast aluminum parts are to be furnished with a baked-enamel paint.

The ballast housing and optical assembly shall be provided with easy-to-read moisture-proof nameplates that can be read without disturbing the luminaire when installed.

Ballast and optical assemblies shall include provision for field mounting of safety chains.

Luminaires shall have a wiring compartment with a single fuse holder.

Mounting of the optical assembly to the ballast assembly or pendant cap shall be secured by positive vibration-proof means. The optical and ballast or pendant cap assemblies shall include a positive aligning electrical disconnect allowing the socket to be shipped factory assembled in the optical assembly.

The luminaire shall be enclosed and gasketed and shall include an activated charcoal filter to permit passage of air.

Heat-resistant polycarbonate plastic shall be used for the refractor. The optical assembly shall be hinged and latched for lamp access. An automatic disconnect shall ensure that optical assembly is electrically cold when servicing. The optical assembly shall be removable from the ballast without tools.

The filter assembly shall be factory installed, but easily removable and shall be located to prevent accidental dislodgement when the luminaire is installed.

The unit shall provide at least 3% uplight dispersed widely across the surrounding area.

Luminaire shall be suitable for continuous service in an ambient temperature of 40°C. The unit shall be weatherproof and dustproof.

Ballasts shall be multi-tap, high power factor, regulator type.

9-31.1(7) WALL-PACK LUMINAIRE

The luminaire shall consist of a rear die-cast back housing which encloses the ballast, lamp socket and reflector, and a refractor frame assembly. The back casting assembly shall mount against the wall (or pole) and the refractor housing assembly shall fasten to it by means of concealed hinges and a single point, positive acting latch. There shall be plated steel retaining chain attached between the main housing and refractor frame. Overall dimensions shall be approximately 16 inches square by 10-3/8 inches deep.

Units shall be prewired and equipped to be wall mounted directly on conduit for surface wiring without bending the conduit or to a recessed outlet box, and shall require no tools for lamp replacement.

The optical train shall consist of the lamp, fluted specular aluminum reflector, and molded prismatic borosilicate thermal shock-resistant glass refractor. The dimensions of the refractor shall be approximately 16 inches square by 4 inches deep and shall have internal splitting prisms and external dispersing prisms. The refractor frame color shall be anodized aluminum.

The integral ballast shall operate the high-pressure sodium 55-volt lamp at the wattage shown on the Drawings, and provide reliable starting at temperatures as low as -20 °F. The ballast shall be multi-tap to allow field adjustments of voltage.

All insulation shall be UL listed Class H; core, coil, and capacitors shall be positioned for maximum heat dissipation. Supply wires to the unit are to be of proper temperature rating for the type of entry used. The housing shall be finished with a black polyester powder paint coating. The complete unit shall be UL listed as "Suitable for Wet Locations". The unit shall be Moldcast catalog no. PCL-1 or approved equal, to be furnished with photocontrol, wireway conduit adapter, and polycarbonate shield.

The wall-pack luminaire shall be furnished with photocontrol, wireway conduit adapter, and polycarbonate shield.

9-31.2 RESERVED

9-31.3 WIRE

Street light wire in conduits shall be stranded copper single conductor, with 600 volt type THWN color-coded insulation, size as indicated on the Drawings, and in accordance with SCL Material Standard 6122.3.

Wire used inside of poles and bracket arms (including wood pole mounted bracket arms) or bonded to signal spanwires shall be No. 10 stranded copper "Pole and Bracket" cable with an insulation thickness of 45 mils and a belt thickness of 95 mils. *Where the proper combination of colored conductors is unavailable in "Pole and Bracket" cable, No. 12 20-10 cable in accordance with SCL Material Standard 6404.4 may be substituted when allowed by the Engineer on a submitted Shop Drawing.*

Duplex wire shall consist of one black conductor and one white conductor for circuits with one "hot" conductor and one neutral conductor; and one black conductor and one red conductor for circuits with 2 hot conductors. Multiple conductors shall be color coded in accordance with the NEC. Neutral wire shall always be white. Ground wires shall be green and insulated. The first hot conductor shall be black, the second hot conductor shall be red, and the third hot conductor shall be blue. Triplex wire shall be used for overhead applications, and shall conform with SCL Material Standard 6007.3 but shall be sized as indicated on the Drawings. Wire shall be continuously color coded. Color coding will not be required for triplex wire.

Plastic molding for covering wire attached to the side of wood poles shall be in accordance with SCL Material Standard 5820.5.

9-31.4 RESERVED

9-31.5 WIRE SPLICES

This standard applies to wire connections made in above grade or below grade installations except where the wires are attached directly to the terminal board. All connectors shall be U.L. or equivalent, labeled and approved for the intended use.

1. **Above Grade Installations:** (Including connections in pole handholes)
 - a. Copper to Copper Connector - The connector shall be a high strength bronze alloy of the split bolt type specified in Material Standard 6688.7.
 - b. Copper to Aluminum Connector - The connector shall be of the one or two bolt type labeled CO/ALR and include an approved spacer bar.
 - c. Aluminum to Aluminum Connector - The connector shall be of the 1 or 2 bolt type and meet the requirements of SCL Material Standard 6693.5.
 - d. Split bolt connections shall be insulated in accordance with Section 8-30.3(5).
2. **Below Grade Installations:** (Including on Structures)
 - a. Below grade splices shall be made in a 2 piece rigid body transparent moisture proof spliced enclosure. The body shall be webbed to ensure centering of the splice and even distribution of the encapsulant. The body and encapsulant shall be composed of Material which do not support fungi

or mold. The encapsulant shall be a reenterable (gel like), transparent type. (Non-reenterable encapsulant may be approved if each splice is approved by the Engineer prior to installing encapsulant.)

- b. *Connectors shall be as described in "a" above, or a copper mechanical crimp type may be used when submitted to, and allowed by, the Engineer at least 3 Working Days in advance of proposed use, or when indicated on a submitted and reviewed by the Engineer Shop Drawing. Mechanical crimp splices shall be made with an approved crimping tool.*
3. **Inside Cabinets and Panels:** Wire nuts may be used only inside cabinets and panels. Copper or silver plated terminals shall be used at terminal blocks.

9-31.6 FUSES AND FUSE HOLDERS

The in-line fuse holder shall consist of a fuse, a two-section fuseholder body and two insulating boots, all rated at 600 volts. The fuse shall be of the voltage and amperage specified. Fuses rated at 30 amps and less shall be 600V AC non-time delay with a 100,000A interrupting rating. The fuse size shall be 13/32 inches by 1-1/2 inches in a holder rated 30 amp, 600V. Fuses rated 30 to 60 amps shall be 300V AC time delay type with a 100,000A interrupting rating. The fuse size shall be 13/32 inches by 2-1/4 inches in a holder rated 60 amp, 300V.

The fuseholder body shall be made of waterproof molded plastic, in two sections: the line-side section and the load-side section. Their purpose is to provide a visible means of disconnect for circuit repairs or maintenance. The fuse shall be held in the load-side section only. Each section shall be totally enclosed at the wire entrance end and the sections shall be joined by a threaded, gasketed joint. The fuseholder body shall be designed to confine any electric arc, should the fuseholder be closed on a live circuit.

Fuse holder terminals shall be compression or screw type, sized for the actual wire utilized. Only one wire shall be installed in any terminal.

Insulating boots shall be used to waterproof the wire connections. The type of insulating boot shall be a single conductor boot for the load-side and a single conductor boot for the line-side.

The fuse shall be a current limiting type with a high speed opening and an interrupting rating of 100,000 rms symmetrical amperes. The fuse shall have a minimum time delay of 25 seconds at 200 percent load, but not great enough to result in a safety loss during overload or short-circuit conditions.

The fuse shall be designed so that the carrying capacity or opening time is little affected by ambient temperature and shall operate with low watt loss to reduce heating.

9-31.7 GROUND RODS, CLAMPS, AND HARDWARE

Ground rods shall be fabricated from cold-finished carbon steel shafting in accordance with ASTM A 108 as it applies to Grade 1018. Galvanized ground rods shall not be used.

The covering of the steel core shall be a sheath of electrolytic-grade copper having a minimum thickness of 0.010 inches. The rods shall have rolled threads at each end for joining together with couplings. Rods shall be 10 feet in length and 5/8 inch diameter. Rods shall conform to SCL Material Standard 5642.1, except for length, and shall conform to NEC requirements.

Couplings for sectional rods shall be made of high-strength, corrosion-resistant bronze, internally threaded to fit standard rods.

Driving studs shall be made of high-strength, hardened steel of SAE 1045 or equal quality.

Ground rod clamps shall meet the requirements of SCL Material Standard 5640.3. Ground rod clamps shall conform to NEC requirements.

Ground plates shall be a minimum of 2 square feet surface area copper plate.

9-31.8 ENCLOSURES

Enclosures located outside shall be weather-proof type, NEMA Type 3R. All doors and covers shall be gasketed. All enclosure metal shall be formed of stainless steel or aluminum as noted on the Standard Plans, and shall be constructed to the dimensions shown on the Drawings. All doors shall be provided with a heavy duty hasp suitable for padlocking.

All joints shall be seam welded. Enclosures shall be fabricated to allow for anchor bolt mounting.

A permanent sign shall be attached to the exterior of the enclosure cover or door. The sign shall be engraved into a 2 inch x 6 inch stainless steel plate with a minimum thickness of 18 gauge. The lettering shall be in 3 lines as follows:

**DANGER
HIGH VOLTAGE
KEEP OUT**

The letters shall be 1/2 inch high with a stroke width of 3/32 inch, and shall be filled with a red paint.

The completed sign shall be coated with a clear polyurethane enamel with exterior catalyst and attached to the enclosure cover with a minimum of 6 stainless steel drive rivets.

9-31.9 RECEPTACLES

All duplex receptacles shall be 20 amp, 125 volt, AC, GFCI, Hospital Grade receptacles, to be UL listed "Hospital Grade" under UL No. 498. Receptacles shall be Hubbell GF-8300, or approved equal.

SECTION 9-32 TRAFFIC SIGNALS SYSTEM**9-32.1 RESERVED****9-32.2 RESERVED****9-32.3 SIGNAL HEADS, VEHICLE****9-32.3(1) GENERAL****9-32.3(1)A SIGNAL HEAD COMPONENTS**

Signal heads shall be in accordance with the "Institute of Transportation Engineers" publication, *current* edition of "ADJUSTABLE FACE VEHICLE TRAFFIC CONTROL SIGNAL HEAD STANDARD" and the following additional requirements:

The Equipment shall be designed for operation under temperature and humidity conditions encountered in the Pacific Northwestern United States.

Materials and workmanship shall conform to the best commercial standards of the industry.

Signal hanger pins shall include a stainless steel washer between each cotter key and the signal hanger.

A terminal block of an approved type shall be mounted inside at the back of each signal head. It shall have sufficient studs to terminate six (6) lamp wires independently to six (6) field wires. The screws shall be of sufficient length to easily accommodate 14 AWG field wires without having to remove the screws. The terminals to which field wires are attached shall be permanently tagged to facilitate field work. Lamp socket wires shall consist of a white wire and a wire of the same color as the lens connected to the terminal block.

All signal heads shall be installed as indicated on the Drawings.

The housing, door, visor exterior and mounting hardware/framework shall be dark green in color. The visor interior and both sides of the back plate shall be optical black or flat black in color. The paint shall be of the best quality synthetic resin enamel.

Adjustable signal heads shall consist of separate signal sections, expandable type, for vertical or horizontal mounting, rigidly and securely fastened together into one weather-tight signal assembly. The signal sections shall be 8 inches or 12 inches in diameter, as indicated on the Drawings.

Each section shall consist of a housing, door assembly, optical unit and backplate and shall be so constructed as to provide complete interchangeability of parts.

Weather-resistant mildew-proof gasketing shall be provided between the housing and door assembly and between the lens and reflector, which shall exclude dust and moisture.

9-32.3(1)B HOUSING

The housing shall be cast aluminum alloy, free of flaws, cracks, blowholes and other imperfections.

Each vehicular signal head shall have a 1/4 inch drain hole in the bottom of the head.

Each section shall house 1 individual optical unit complete with 1-piece hinged square door, mounting for the lens and other parts of the optical system and a simple noncorrodible door-locking device.

Sections shall be interchangeable and so constructed that sections can be added or removed. The top and bottom shall be drilled for 1-1/2 inch supporting pipe fittings. Hexagonal heavy plumbers lock nuts 2-1/2 inches across flats for 1-1/2 inch pipe shall be provided for top and bottom.

The 4 backplate mounting holes (2 in the top of the backplate and 2 in the bottom of the backplate) shall be a maximum distance of 1-1/4 inches on 8 inch signal and 2-1/2 inches on 12 inch signals from the top or bottom edge of the signal housing.

9-32.3(1)C DOOR ASSEMBLY

The door assembly shall consist of the door, lens and visor.

The door of each section shall be made of aluminum alloy and shall be hinged to the housing so as to permit access or removal. The door shall be secured to the housing by a single finger type locking device. The door-locking device shall be easily removable to allow door removal.

Each section shall have a visor made from aluminum alloy sheet of a tunnel design attached to the door by means of 4 panhead screws. The mounting holes shall be slotted. Visor length shall be 8 inches for 8 inch signals and 12 inches for 12 inch signals.

The lens shall be glass, circular in shape of the color, type and size specified. The lens shall be designed to give an outward distribution of light with a minimum above the horizontal. Each lens shall be true to color and shall conform to the current ITE Standard. The lenses shall have a minimum visible diameter of 7-3/4 inches (eight inches nominal) or 11-1/2 inches (12 inches nominal).

9-32.3(1)D OPTICAL UNIT

The optical unit consists of the reflector and lamp receptacle and shall be so mounted to the housing that it can be swung open for ready access or removal without the use of tools. The optical unit lens and visor shall be designed as a whole to reduce sun-phantom. Lamp re-placement shall be through the parabolic side of the reflector, and shall not require removal of the lamp holder from the reflector unit.

The reflectors shall be constructed of silvered glass or specular alzak aluminum in a parabolic design. An opening in the back of the reflector for a lamp holder shall be constructed to eliminate dark spots on the lens.

Relamping and cleaning of reflectors shall be easily accomplished upon opening of the door without removal of screws or mounting framework inside the housing.

The lamp receptacle shall be of weather-proof molded construction immune to the operating temperatures in the unit and shall be provided with 2 wires of sufficient length to be connected to the terminal block.

Traffic signal lamps shall meet the following requirements and the current Institute of Transportation Engineers' Specifications:

Lens Size	Voltage	Rated Life	Initial Lumen Output
8 inch	120 V	8000 Hr.	665
12 inch	120 V	8000 Hr.	1950

9-32.3(1)E BACKPLATE

The signal, with backplate, shall be designed to meet or exceed the load requirements in accordance with Section 2 of "Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals", AASHTO 1994 edition. Back plates shall be furnished and attached to each signal head assembly. Back plates shall be louvered type to reduce wind loading, constructed of anodized, 3-S half-hard aluminum sheet, 0.058 inches minimum thickness. The back plates shall be riveted together with a minimum of 8 5/16 inch stainless steel pop rivets. No bolts or screws will be permitted. Back plates shall not interfere with either the operation of the door or the mounting of the signal. Mounting hole pattern shall match pattern on signal head housing. The front and back of the back plates shall be finished with 2 coats of flat black enamel.

Back plates shall be permanently attached so as to provide a 5 inch border for either 8 inch or 12 inch signal heads. On combination heads (i.e., 12 inch and 8 inch sections) the back plate shall have a 5 inch border relative to the 8 inch head. Therefore, the border on the 12 inch head shall be approximately 3 inches.

Back plates shall be provided with a minimum of 2 mounting holes per signal section, one on each side. The 2 top and 2 bottom backplate mounting holes shall be a maximum distance of 1-1/4 inch from the corners of an 8 inch signal housing, and 2-1/2 inch from the corners of a 12 inch signal housing.

9-32.3(2) BI-MODAL VEHICLE SIGNALS SECTION

The signal section shall display both yellow and green arrow indications from the same face and shall use a fail-safe 2-lamp system to direct light of either color into a fiberoptic display. The section shall be adaptable to conventional 12 inch vehicle signal heads.

9-32.3(3) OPTICALLY PROGRAMMED VEHICLE SIGNAL SECTION

The signal shall permit the visibility zone of the indication to be determined optically and require no hoods or louvers. The projected indication may be selectively visible or veiled anywhere within 15 degrees of the optical axis. No indication shall result from external illumination nor shall one light unit illuminate a second.

The components of the optical system shall comprise: lamps; lamp collar; optical limiter - diffuser; and objective lens.

The lamp shall be nominal 150 watt (75 watt for distance-limiting applications), 120 volt AC, three-prong, sealed beam having an integral reflector with stippled cover and an average rated life of at least 6,000 hours. The lamp shall be coupled to the diffusing element with a collar including a specular inner surface. The diffusing element may be discrete or integral with the convex surface of the optical limiter.

The optical limiter shall provide an imaging surface at focus on the optical axis for objects at a distance of 900 to 1200 feet, and permit an effective veiling mask to be variously applied as determined by the desired visibility zone. The optical limiter shall be provided with positive indexing means and composed of heat resistant glass.

The objective lens shall be a high resolution planar incremental lens hermetically sealed with a flat laminate of weather resistant acrylic or approved equal. The lens shall be symmetrical in outline and may be rotated to any 90 degree orientation about the optical axis without displacing the primary image.

The optical system shall accommodate projection of diverse, selected indicia to separate portions of the roadway such that only one indication is simultaneously apparent to any viewer after optically limiting procedures have been accomplished. The projected indication shall conform to ITE transmittance and chromaticity standards.

9-32.3(4) DIRECTIONAL LOUVERS

Where so indicated on the Drawings, louvers shall be furnished and installed in signal visors. Directional louvers shall be so constructed as to have a snug fit in the signal visor. The outside cylinder shall be constructed of No. 22 U.S. gauge sheet steel, and the vanes shall be constructed of No. 27 U.S. gauge sheet steel. Dimensions and arrangement of vanes shall be as indicated on the Drawings.

Louvers shall be galvanized after fabrication by the hot dipped process in conformance with ASTM A 153 and painted flat black.

9-32.3(5) LED TRAFFIC SIGNAL RED SECTION

All vehicle signal head sections shall be provided with a Light Emitting Diode (LED) technology rather than incandescent, unless specified otherwise in the Contract. A sample of the LED module to be used, the manufacturer's specifications, and a Manufacturer's Certificate of Compliance to the specifications shall be provided to the Engineer for

approval. If *approved*, the sample will then be held for comparison to the remainder of the units to be installed. Written approval by the Engineer will be required prior to installation.

LED modules shall fit into *Traffic* signal housings built to the VTSCCH Standard without modification to the housing and shall not require special tools for installation. The module shall replace red section's optical unit components, i.e., lens, lamp holder, gaskets, and reflector. It shall be weather tight and fit securely in the housing and shall connect directly to the electrical wiring terminals.

The lens Materials to enhance ON/OFF contrasts shall not affect luminous intensity or chromaticity and shall be uniform across the face of the lens and shall be UV stabilized. The lens shall be a replaceable part without the need to replace the complete module.

The module shall be a single, self-contained device and with its power supply packaged within the module enclosure and shall be completely protected against dust and moisture intrusion.

The LED signal module shall be rated for use in the ambient operating temperature range of -40°C (-40°F) to +74°C (+165°F).

The LED signal modules when operated at nominal voltage and 25°C (77°F) shall provide a power factor of .90 or greater and a total harmonic distortion not to exceed 20 percent on modules with power consumption of 15 watts or greater and 40 percent for modules with power consumption of less than 15 watts.

All electronic components shall be adequately supported to withstand mechanical shock and vibration from high winds and other sources. Materials used for the module enclosure shall be made of UL94VO flame retardant with the exception of the lens. The lens shall have no scratches (abrasions), cracks, chips, discoloration, or other defects. Any such defects shall be cause for rejection.

Each individual LED signal module shall be identified for warranty purposes, nominal operating voltage, power consumption, volt-ampere and a vertical indexing indicator for correct orientation.

The minimum luminous intensity throughout its useful life and at the end of the warranty period, shall not be less than the values shown in Table 1 Section 4.1 of the ITE Specifications for LED *Traffic* signal modules. When operating within the temperature range specified in Section 3.3.1 during the warranty period, the maximum luminous intensity shall not exceed 800 candelas for the red.

The electrical, wiring and terminal blocks shall meet the requirements of section 13.02 of the VTCSH standard. Fluctuations in line voltage over the range of 80VAC to 135VAC shall not affect luminous intensity by more than ±10 percent. The circuitry shall prevent perceptible flicker and include voltage surge protection to withstand high-repetition noise transients and low-repetition high-energy transients as stated in Section 2.1.6, NEMA Standard TS-2, 1992. A catastrophic failure of one LED light source shall result in the loss of not more than 5 percent of the signal module light output. The module shall be operationally compatible with NEMA (TS-1 or later) load switches. All LEDs shall be of the AllnGap technology or proven equal in brightness and bulb life.

Manufacturers shall replace or repair an LED module that fails to function as intended due to workmanship or Materials defects, or if it exhibits luminous intensity of less than the minimum values specified within the first 60 months from the date of installation.

9-32.4 SIGNAL HEADS, PEDESTRIAN

9-32.4(1) GENERAL

The pedestrian signal head shall consist of a message module, case, eggcrate visor, transformer, and directional louvers.

The entire pedestrian signal including neon tubing, transformers, and all ABS or polycarbonate plastic parts shall be warranted against defects in workmanship, or Materials, or both.

The case, sun shield and mounting hardware shall be painted dark green in color. The eggcrate visor interior and directional louvers shall be painted flat black in color.

The maximum overall dimension of the signal shall be 19-1/2 inches wide, 19 inches high and 9 inches deep, not including eggcrate visor and hinges. In order to facilitate installation and maintenance, the signal shall be designed so that all components are readily accessible from the front by merely opening the signal door.

Pedestrian signals shall display international symbols (Portland orange "Up Raised Hand" and the lunar white "Walking Person") illuminated by multiple configuration neon tubes encased in a molded plug-in plastic message module. The Hand-Person symbols shall be a minimum of 12 inches in height and 7 inches in width.

9-32.4(2) MESSAGE MODULE

The message module shall consist of 2 neon gas tubes enclosed and thus protected by a housing made of white acrylonitrile butadiene styrene or polycarbonate plastic and a screened message lens made of polycarbonate plastic.

The tube used for the Portland orange hand symbol shall be coated on the inside with fluorescent Material producing the desired Portland orange output. Tubing for the lunar white person symbol shall be coated on the inside with fluorescent Material producing the desired lunar white output. It shall be formed to the approximate shape of the person and shall be positioned for maximum lunar white intensity.

The 2 neon tubes shall be enclosed in a single plug-in plastic module via resilient rubber adhesive to prevent transfer of mechanical strain to the glass tubing and to provide effective shock mounting. The plastic housing shall be molded in a manner to provide positive location of the neon tubing in relation to the screened message lens.

The message lens shall consist of 1/8 inch minimum thickness clear, U.V. stabilized refractor type, polycarbonate plastic with outer prisms and shall be weather, craze and heat resistant. The prism pattern shall face the outside of the module with the screened message enclosed within the module.

The inside face of the message lens shall be painted in all areas except where the desired symbols are formed. The first coating of paint shall be black to form a contrasting background when viewed from the outside. The second coating of paint shall be white to reflect internal light.

The message module shall be sealed into an integral assembly with a 1 piece sponge neoprene gasket fitted around the perimeter to provide positive protection of the enclosed neon tubing from handling, weather, and moisture.

The message module shall be provided with electrical contacts which plug directly into recessed contacts in the transformer enclosure when the module is in proper position and shall not require the use of tools for insertion or removal.

Neon pedestrian signal excitation shall be by transformer only. Electronic models are not acceptable.

9-32.4(3) CASE

The case shall consist of a housing and door each made from 1 piece, aluminum alloy die casting. It shall be dustproof, weatherproof and corrosion resistant and shall provide for easy access to and replacement of all components. The housing shall have an integral cast top, bottom, sides, and back. Four integrally cast hinge lug pairs shall be provided for operation of a swing down door.

The housing shall be suitable for left or right hand (with pre-drilled holes and rubber plugs) clamshell mounting hardware, post-top mounting, or bracket mounting.

The top and bottom of the housing shall have an opening to accommodate 1-1/2 inch pipe brackets. The bottom opening of the signal housing shall have a standard 72 tooth locking boss integrally cast into the case. The teeth shall be clean and sharp and provide full engagement. The radial angular grooves of the boss shall provide positive positioning of the entire signal to eliminate rotation or misalignment of the signal.

The door shall be attached to the case by means of 2 stainless steel spring pins. 2 stainless steel hinged bolts with captive stainless steel wingnuts and washers shall be attached to the case with the use of stainless steel spring pins. Hence, latching or unlatching of the door shall require no tools.

A 1/4 inch drain hole shall be provided in the bottom of the case. All unused openings shall be capped with corrosion-resistant metal caps, and weatherproofed with approved washers.

Clamshell mounting shall be a two-piece cast aluminum alloy assembly. One piece shall be the pole "half", the other piece the signal housing "half". The clamshell assembly shall have two integrally cast hinge lug pairs so, that when the clamshell is mounted in final position for pedestrian *Traffic*, the clamshell shall rotate horizontally to the open position for easy access to the control wiring inside the clamshell.

9-32.4(4) EGGCRATE VISOR

Each signal shall be provided with an eggcrate type visor designed to eliminate sun phantom.

The eggcrate type visor shall be installed parallel to the face of the Hand - Person message lens and shall be held in place by stainless steel screws. The eggcrate assembly shall consist of vertical members and horizontal members. The completed assembly shall be approximately 1-1/2 inches deep.

The basic Material used in construction of the eggcrate shall be nominally 0.030 inches thick polycarbonate plastic. Additional members may be employed outside the two legend areas but are not required unless needed to develop the full potential structural strength attainable through the particular assembly technique employed.

The assembly shall be enclosed in a mounting frame constructed of 0.040 inches minimum thickness aluminum or polycarbonate plastic. This frame shall be approximately 1-1/2 inches deep and may contain alternate mounting holes for use on alternate types of pedestrian signals.

9-32.4(5) TRANSFORMERS

Two transformers shall be provided with recessed secondary contacts. Each transformer shall have as a minimum 4000 volt, 30 milliampere secondary.

Each transformer shall have 120 volt (nominal) primary windings and a power factor of 90 percent minimum.

A fused switch consisting of 2 cartridge fuses and a lever for disconnecting the fuses shall be provided inside the case on a terminal block for de-energizing the transformer primary circuit. The terminal blocks shall accommodate no less than 5 terminals.

9-32.4(6) OPTICALLY PROGRAMMED PEDESTRIAN SIGNAL (2-SECTIONS)

Each signal head shall permit the visibility zone of the indication to be determined optically and require no hoods or louvers. The projected indication may be selectively visible or veiled anywhere within 15 degrees of the optical axis. No indication shall result from external illumination nor shall one light unit illuminate a second.

The components of the optical system shall comprise: (a) lamp; (b) lamp collar; (c) optical limiter-diffuser; and (d) objective lens.

The lamp shall be nominal 75 watt PAR, 120 volt AC, three-prong, sealed beam having an integral reflector with stippled cover and an average rated life of at least 6,000 hours. The lamp shall be coupled to the diffusing element with a collar including a specular inner surface. The diffusing element may be discrete or integral with the convex surface of the optical limiter.

The optical limiter shall provide an imaging surface at focus on the optical axis for objects 900 to 1200 feet distance, and permit an effective veiling mask to be variously applied as determined by the desired visibility zone. The optical limiter shall be provided with positive indexing means and composed of heat resistant glass.

The objective lens shall be a high resolution planar incremental lens hermetically sealed with a flat laminated weather resistant acrylic or approved equal. The lens shall be symmetrical in outline and may be rotated to any 90 degree orientation about the optical axis without displacing the primary image.

The optical system shall accommodate projection of diverse, selected indicia to separate portions of the crosswalk such that only one indication shall be simultaneously apparent to any viewer after optically limiting procedures have been accomplished. The projected indication shall conform to ITE transmittance and chromaticity standards.

9-32.5 PEDESTRIAN PUSHBUTTON ASSEMBLY

The assembly shall consist of a pushbutton, deep cast aluminum box, molded one-piece aluminum mount, with signs and mounting hardware as indicated on the Standard Plan no. 522.

The pushbutton shall be of tamperproof and all weather construction. The pushbutton shall consist of a 2-1/4 inch chrome plated metal plunger and an oil tight switch with single momentary silver contact, rated 125 volts, 10 amperes, all encased in a metal enclosure with stainless steel mounting screws.

The assembly shall be made weatherproof and shockproof by means of synthetic rubber gaskets between the cover and the enclosure and between the plunger and the cover so that it shall be impossible to receive an electrical shock under any weather conditions.

9-32.6 DETECTOR LOOPS

Detectors shall be used for actuating *Traffic*-actuated controllers and sample stations. A complete detector loop installation shall consist of loop wire and lead-in cable from the loop to the amplifier.

Loop wire shall be #14 AWG Class B (104 X 34) stranded tinned copper, high density polyethylene insulated with a .032 inch minimum thickness.

The lead-in from the detector junction box to the controller cabinet or remote amplifier cabinet shall be either single pair #16 AWG 19 X 29, three pair #20 AWG 10x30, or 6 pair #20 AWG 10x30 stranded tinned copper, polyethylene insulated, PVC jacketed, twisted pair cable(s) with copper foil or aluminum-polyester shield. The three pair and the six pair lead-in cables shall have a #22 AWG stranded tinned-copper drain wire. The conductors shall be twisted together approximately 3 turns per foot. Connections of the loop wire to the lead-in wire shall be made only in a handhole with a waterproof splice as indicated on the Drawings.

9-32.7 OVERHEAD INTERIOR ILLUMINATED SIGN

The equipment shall be designed and manufactured for operation under temperature and humidity conditions encountered in the Pacific Northwestern United States.

The sign, when mounted, shall be designed to meet or exceed the load requirements in accordance with Section 2 of "Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals", AASHTO 1994 edition.

The sign size shall be as indicated on the Drawings. The housing shall be a double faced design made of extruded aluminum alloy or polyvinyl, dark green in color or with a brushed aluminum finish. The interior shall be painted white.

Standard signal mounting hardware shall be used to mount illuminated signs to all street furniture. The sign shall be fitted with a 1-1/2 inch iron pipe (IP) with tapped straight thread hub on top, for mast arm and span wire mount, and on top and bottom for bracket mount.

The front message panel shall be translucent white Rohm and Haas Plexiglass, or Tuflite white fiberglass, or equal. The back message panel shall be constructed of aluminum alloy or polyvinyl, colored dark green or brushed aluminum finish to match the housing, unless the sign is double faced in which case it shall be the same as the front message panel. Sign message shall be as indicated on the Drawings.

A terminal block for power input hookup shall be accessible by opening either message panel.

Signs shall be completely wired and assembled.

Unless otherwise indicated in the Contract, the sign shall be equipped with 4-24 inch T12-CW fluorescent tubes with weatherproof tube type sockets and ballast transformer. The ballast transformer shall be non-flashing 425 mil-amp type, 0°F starting, 120 VAC, 60 Hz.

Hardware (i.e., rivets, screws, bolts, nuts, etc.) and non-aluminum parts shall be stainless steel.

Each interior illuminated sign assembly shall be fused. All fuses shall be accessible by opening either of the message panels. Both message panels shall be of the sliding type with stop bars to prevent total removal, and for ease of maintenance.

9-32.8 RESERVED

9-32.9 INTERCONNECT CABLE

9-32.9(1) UNDERGROUND

Interconnect cable (UIC) shall be #19 or #22 solid aerial/duct communication cable and shall conform to REA Specification PE-39 or I.M.S.A. Specification No. 20-2. The number of pairs and size shall be as indicated on the Drawings.

9-32.9(2) AERIAL ("FIGURE 8")

Interconnect cable (AIC) shall be #19 or #22 solid "figure 8" communication cable and shall conform to REA specification PE-38, or I.M.S.A. specification no. 20-4. The number of pairs and size shall be as indicated on the Drawings.

9-32.9(3) INDOOR

Interconnect cable shall be #19 or #22 multiple pair communications cable and conform to REA specification PE-22, or I.M.S.A. specification no. 20-2. The number of pairs and size shall be as indicated on the Drawings.

9-32.10 RESERVED**9-32.11 SIGNAL WIRING****9-32.11(1) TRAFFIC SIGNAL CABLE**

Color Code Base/Tracer)	1c	2c	3c	5c	7c	10c	13c
Black	#12	#14	#14	#14	#14	#14	#14
White	---	#14	#14	#14	#14	#14	#14
Red	---	---	#14	#14	#14	#14	#14
Green	---	---	---	#14	#14	#14	#14
Orange	---	---	---	#14	#14	#14	#14
Blue	---	---	---	---	#14	#14	#14
White/Black	---	---	---	---	#14	#14	#14
Red/Black	---	---	---	---	---	#14	#14
Green/Black	---	---	---	---	---	#14	#14
Orange/Black	---	---	---	---	---	#14	#14
Blue/Black	---	---	---	---	---	---	#14
Black/White	---	---	---	---	---	---	#14
Red/White	---	---	---	---	---	---	#14

Signal Cable shall have solid copper conductors and shall conform to I.M.S.A. specification No. 20-1 (polyethylene insulated, polyethylene jacketed signal cable).

9-32.11(2) PEDESTRIAN PUSH BUTTON CABLE

Pedestrian push button cable shall be single pair #16 AWG 19x29 stranded copper, polyethylene insulated, PVC jacketed, twisted pair cable with copper or aluminum-polyester shield and a No. 18 AWG stranded tinned-copper drain wire. The conductors shall be twisted together approximately 3 turns per foot.

9-32.11(3) ELECTRICAL SERVICE CONNECTIONS

All *Traffic* signal services shall be 2 parallel 120 volt, 60 HZ AC electrical services with accompanying equipment.

Individual service conductors shall be color or number coded type XHHW or THWN No. 6 AWG stranded copper. The outer jacket of cable shall be flame retardant, moisture, heat and sun light resistant thermoplastic or cross linked synthetic polymer suitable for underground conduit or aerial installation with suitable non-hygroscopic fillers.

All final connections and energizing of signal systems (overhead secondary or secondary in vaults or handholes) shall be performed by Seattle City Light.

9-32.11(4) FUSES AND FUSE BLOCKS

See Section 9-31.6.

9-32.11(5) POLE JUNCTION BOXES AND TERMINAL BOXES

Junction and terminal boxes shall be watertight (NEMA 4) rated, cast iron box and cover. Finish shall be hot dipped galvanized. Cover shall mount with a neoprene gasket and brass cover screws. Top and bottom conduit holes shall be bossed, drilled and tapped. Conduit holes in rear of terminal boxes shall be drilled and tapped. The threads in poles and junction boxes shall be sealed to prevent water entry and rusting. Cabinet size shall be as indicated on the Drawings.

9-32.11(6) GROUND RODS, CLAMPS AND BONDING

See Section 9-31.7.

9-32.11(7) SQUEEZE CABLE FITTINGS

Cable fittings for entry of cable through metal walls of poles, signs and signals shall be squeeze-type cable fittings with water-tight neoprene bushings. Size shall be carefully chosen to match the cable diameter to assure a water-tight fitting without damaging the cable.

9-32.12 SPAN WIRE

Span wire shall be 5/16 inch, 7-strand aluminum covered steel span wire conforming to ASTM B 415 with rated breaking strength of 10,270 lbs. in accordance with SCL Material Standard No. 5664.1.

Catenary span wire shall be 7/16 inch, 7-strand aluminum covered steel span wire conforming to ASTM B 415 with rated breaking strength of 20,800 lbs. in accordance with SCL Material Standard No. 5664.1.

9-32.13 POLE LINE HARDWARE

Strain insulators shall be wet process, porcelain, conforming to EEI-NEMA TDJ-54 as follows:

5/16 inch wire	Class 54-2
7/16 inch wire	Class 54-3

Tether wire shall be 1/8 inch galvanized steel stranded wire conforming to ASTM A 475, extra high strength grade (rated at 1500 pounds minimum), Class A galvanized.

Bull rings (purse seine rings) shall be low carbon steel with an ultimate strength of 25,000 pounds. The ring shall be closed with a weld equal to or greater than 90 percent of the unwelded steel. The ring shall be galvanized with at least 2 ounces of zinc per square foot, which is equivalent to 3 mils of thickness. The steel shall be 3/4 inches in diameter and shall form a ring with a 3 inch ID. Higher strength steel shall be used when more than 4 signal heads are being supported.

All pole hardware, bolts, plate rods, hangers, clamps, wire guards and pole bands shall be hot-dipped galvanized in conformance with the requirements of ASTM A 153, or shall be stainless steel.

All miscellaneous pole line hardware required to complete the Project as planned shall be standard Material manufactured for pole line construction.

9-32.14 GALVANIZING REPAIR PAINT

Field repair of galvanized surfaces shall be a coating of heated zinc alloy solder to a minimum thickness of 2 mils in accordance with ASTM A 780.

SECTION 9-33 POLES, PEDESTALS, AND FOUNDATIONS**9-33.1 GENERAL****9-33.1(1) POLES, MAST ARMS, AND LUMINAIRE ARMS**

All metal poles, mast arms and luminaire arms shall be designed and fabricated to conform with the requirements of AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals", 1994 edition (hereinafter referred to as "AASHTO"), and EEI-TDJ 135 and 139. All load requirements shall be accommodated as indicated on the Standard Plans.

Poles shall be galvanized steel, timber, or aluminum in accordance with the Drawings.

Poles not meeting the requirements of the Drawings and Specifications will be rejected.

9-33.1(2) ANCHOR BOLTS

Anchor bolts for lightpoles (steel or aluminum) shall conform to ASTM A 307 or ASTM A 576, unless otherwise specified in the Contract. Anchor bolts for steel strain poles Type T, and mast arm poles shall conform to ASTM A 576 (Type 1040 or 1045), ASTM A 675 (Gr. 90), or ASTM A 36 Mod, with $F_y = 55$ ksi minimum. Anchor bolts for steel strain poles Types V, X, Z shall conform to ASTM A 354, Gr. BC, or ASTM A 687. Each anchor bolt shall have a hexagonal leveling nut with a washer for leveling and a hexagonal nut with a flat washer and a lock washer for the top of the anchor base plate. All anchor bolts (full length), nuts and washers shall be galvanized in accordance with ASTM A 153. Anchor bolts shall not be bent or cut after fabrication. Bending of anchor bolts shall be cause of rejection and removal of entire foundation.

Anchor bolt extenders (sleeve nuts), where required, shall be of a strength greater than the existing anchor bolts. The bolt extenders shall have a hexagonal tightening nut, and shall be galvanized in accordance with ASTM A 153.

9-33.1(3) GALVANIZING

Before galvanizing, all sharp edges on welds and cut-ins inside the pole shaft, mast arm and luminaire arms shall be removed or filed smooth to prevent damage to the wires in the pole.

Structural Material shall be zinc-coated by hot-dip process in accordance with ASTM A 123 and the final coating shall measure 0.003 inches or more in thickness as determined by a magnetic thickness gauge. Hardware and appurtenances shall be coated in accordance with ASTM A 153. Threads shall be re-cut after galvanizing without exposing base metal. Galvanizing certification of compliance with the applicable ASTM Standards signed by an ASTM accredited independent testing Laboratory shall be submitted to the Engineer before shipment.

The finished pole shall be straight and free from injurious defects. Poles distorted by the galvanizing process shall be straightened without damage to the galvanizing coating. The finish coating shall be smooth and free of dross. After galvanizing, the interior of the pole and arms shall be free from sharp edges to prevent damage to wiring.

9-33.1(4) GROUND LUGS

Metal poles shall have a 3/8 inch tapped hole in the bottom edge of the handhole inside the pole. A 3/8 inch stainless steel bolt with stainless steel lock washer suitable for grounding shall be provided.

9-33.1(5) NUT COVERS

On light poles, the Contractor shall furnish and install separate nut covers to cover anchor bolts and nuts only (not the base flange). Nut covers shall fit snugly to the bolt. Nut covers shall be made of the same Materials as the pole and shall be provided by the pole manufacturer. Nut covers are not required on steel strain or Chief Seattle base type poles unless specified on the Drawings.

9-33.1(6) CONCENTRICITY

Unless otherwise noted on the Drawings, poles, mast arms, and luminaire extensions shall be within plus or minus 1/16 inch of perfect round with a constant taper of approximately 0.14 inches per foot and of uniform thickness.

9-33.1(7) GROUT

Grout shall conform to the requirements of Section 9-04.3(2) for non-shrink cement sand grout.

9-33.2 STEEL POLES, MAST ARMS, BRACKET ARMS, AND LUMINAIRE EXTENSIONS**9-33.2(1) GENERAL**

Poles shall be inspected for Material compliance and acceptance by the Engineer prior to installation.

The term "steel strain pole" as used herein refers to any steel pole subjected to a span wire load (including METRO trolley loads) or mast arm load. Luminaires or other street lighting appurtenances may be mounted on a "steel strain pole". The term "steel lighting pole" refers to any steel pole which carries a luminaire but does not carry a span wire or mast arm load.

The length of the mast arm, height of pole, and size and type of luminaire extension shall be as indicated on the Drawings. An aluminum or stainless steel pole identification plate shall be securely attached immediately above the handhole, and shall indicate gauge, manufacturer, bolt circle, design principle moment in kip-feet, length, and date of manufacture.

Outside diameter of pole shafts shall be as indicated in the Standard Plans.

9-33.2(2) STRENGTH AND DEFLECTION REQUIREMENTS

The pole shaft shall have strength sufficient to support all indicated loads.

The following design loads shall be used: Dead load shall consist of the weight of the signals, luminaires and bracket arms, signs and supporting structure, and associated appurtenances; wind and ice loads shall be as indicated by AASHTO. The signal head mast arm shall be of such size and gauge as to resist the bending moment.

The design of steel strain poles that support overhead trolley loads shall be governed by King County METRO Transit design standards as detailed on the Drawings.

Structural steel having a yield point of 33,000 psi or more shall be used for all structural parts. Silicon content of the steel shall be no more than 0.06 percent to prevent discoloration during galvanizing.

The total deflection at the top of metal poles resulting from all dead loads applied shall not exceed 2.5 percent of pole height.

The deflection of the mast arm after loading shall not cause the end of the mast arm to extend below a horizontal line from the center of the arm flange. The maximum rise of the mast arm after loading from a horizontal line shall be 2 degrees.

The tenon for the luminaire shall be between 1 and 4 degrees above horizontal with the luminaire installed and all other loads applied to the pole.

9-33.2(3) BOLT CIRCLE

Mast arm flange and pole base bolt circles shall be as indicated on the Standard Plans.

9-33.2(4) WELDS

Circumferential butt welds shall have permanent back-up rings and full penetration for 100 percent of the circumference. All exposed butt welds shall be ground flush. All welds shall conform to the requirements of Section 6-03.3(25).

9-33.2(5) HANDHOLES, FESTOONS, AND CABLE OUTLETS ON POLES

Steel poles shall have one oval 4 inch x 6-1/2 inch handhole, as shown in the Standard Plans, reinforced so as to result in no loss of shaft strength. The handhole shall have matching cover attached with stainless steel bolts. The cover shall be rain tight and removable. The handhole shall be fabricated into the pole in a position 90 degrees clockwise from the side on which the bracket or mast arm is attached.

Festoon outlets, when required, shall be as indicated in the Standard Plans.

Cable outlets (on poles) as shown on Standard Plan no. 563b shall be schedule 40 steel pipe extending perpendicularly from the pole. Both ends of the pipe shall be rounded for wire protection. The cable outlet shall be installed, drilled and edges rounded before galvanizing.

9-33.2(6) RESERVED**9-33.2(7) ANCHOR BASE PLATES**

A one-piece steel anchor base plate shall be secured to the lower end of the shaft by continuous electric arc welds as shown in the Standard Plans. The welded connection shall develop the full strength of the adjacent shaft section.

9-33.2(8) POLE AND MAST ARM CAPS

All metal poles (except davit poles) and mast arms shall be equipped with a rain-tight pole cap constructed of the same Material as the pole, and attached with stainless steel bolts.

9-33.2(9) BRACKET ARMS

Luminaire bracket arms shall be per SCL Material Standard 5705.1 or 5705.2 or manufactured as indicated on the Standard Plans and in accordance with AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals", 1994 edition, to support a luminaire of 50 pounds, a 1.2 square foot effective projected area for an 80 mph wind and a coefficient of height of 1.10. Brackets shall include the bolts, nuts and washers galvanized for wood and steel pole mounting and stainless steel for aluminum pole types. Bracket arms shall be the same style as depicted on the Drawings. *Small differences in dimensions may be acceptable to the Engineer when structural calculations accompany these indicated dimension differences on the Shop Drawings (see Section 1-05.3(2)F).*

Luminaire bracket arms shall accommodate a slipfitter luminaire attachment. The terminal end of the arm shall be a straight, tubular section with external dimensions of 2 inches NPS by 6-1/2 inches long.

Bracket arms mounted on metal poles shall be constructed of the same Material as the poles. If the bracket arm and metal pole are of dissimilar metals, they shall be separated by an approved plastic dielectric pad of 5 mils minimum thickness.

The longitudinal axis of the luminaire end of the luminaire support arm shall be not less than 1 degree nor more than 4 degrees above the horizontal with the luminaire installed.

All tubing used for aluminum arm members shall be seamless, Alloy 6063 - heat treated to T-6 after fabrication. Aluminum arms shall meet the requirements of EEI-TDJ 135 & 139. Steel luminaire arms shall meet the requirements of EEI-TDJ 137 & 139.

9-33.3 ALUMINUM POLES

Aluminum street light poles shall meet the requirements of SCL Material Standard 5739.8, except as modified herein and in the Contract.

The shaft shall be round with a continuous taper of approximately 1/8 inch per foot, and shall be made of a high-strength, corrosion-resistant aluminum alloy. The shaft shall have a satin finish, and shall be protected with a wrapping during shipping and installation. A rip cord shall be provided for easy removal of wrapping. An aluminum pole cap shall be attached with stainless steel bolts. Bracket arm flange shall be as indicated on the Drawings. The diameter at the top of the pole shall be 4-1/2 inches \pm 1/8 inch.

Poles shall have an oval 4 inch x 6 inch minimum handhole fabricated into the pole in a position 90 degrees clockwise from the side on which the bracket arm is located and reinforced so as to result in no loss of shaft strength. The handhole shall have a matching aluminum cover attached with stainless steel bolts and shall be located 18 inches above the base plate.

Cast aluminum anchor and transformer base shall be made of high-strength, corrosion-resistant aluminum alloy of sound and uniform quality.

Anchor base poles shall have a 3/8 inch tapped hole in the bottom edge of the handhole and 3/8 inch stainless steel bolt and lock washer for grounding. Transformer bases shall have the ground lug inside the base adjacent to the access door. The lug shall be equipped with a stainless steel bolt (1/4 inch minimum), nut and lockwasher.

Anchor bolts for aluminum poles shall be the same as required for steel poles.

9-33.4 WOOD POLES**9-33.4(1) GENERAL**

Strain poles shall be either Douglas Fir, class 1, or Western Red Cedar, class 1.

Street light poles shall be Western Red Cedar, class 4.

Poles shall be framed (notched) before treatment with a 1/2 inch deep by 2 inch high setting gain on the pole face, 12 feet from the pole butt.

Poles shall be branded by burning the pole face, as specified by ANSI 05.1, 12 feet, 6 inches above the pole butt. Metal marking tags will not be accepted.

Poles shall be butt-treated in accordance with AWPA C7, and the entire butt section of the pole shall be incised. After framing and roofing, the cuts shall be well brushed with the hot preservative.

9-33.4(2) DOUGLAS FIR

Doug fir wood poles shall meet SCL Material Standard 5082.0.

9-33.4(3) WESTERN RED CEDAR

Western red cedar wood poles shall meet SCL Material Standard 5071.0.

9-33.5 RESERVED**9-33.6 STEEL PEDESTALS AND ALUMINUM PEDESTALS****9-33.6(1) STEEL PEDESTALS**

Shafts shall be constructed of welded structural steel, open-hearth lap welded steel or standard steel pipe conforming to the requirements of ASTM A 53. Shafts shall be 4 inch schedule 40 galvanized steel pipe with threaded end for mounting to the base. The overall height of the shaft and base shall be as indicated on the Drawings.

Pedestal base shall be of cast iron conforming to the requirements of ASTM A 48, Class 40 and made in accordance to the configuration on the Standard Plans. Bases for pedestals shall be threaded, octagonal cast iron equipped with an

access door for wiring. A 13-1/2 inch diameter bolt circle size shall be used. The base shall have a grounding lug inside which is accessible from the handhole. The base shall be silver in color.

9-33.6(2) ALUMINUM PEDESTALS

Shafts shall be 4 inch schedule 80 aluminum pipe with one threaded end for mounting to the base. The overall height of the shaft and base shall be as indicated on the Drawings.

Pedestal base shall be of cast aluminum conforming to the configuration on the Standard Plans. Bases for pedestals shall be threaded, square, aluminum and equipped with an aluminum access door for wiring. A 13-1/2 inch diameter bolt circle size shall be used. The base shall have a grounding lug inside which is accessible from the handhole. The base shall be aluminum in color.

9-33.7 PEDESTRIAN PUSHBUTTON POSTS

Pedestrian pushbutton posts shall be constructed of 2 inch I.D. schedule 40 galvanized steel pipe with length as indicated on the Drawings. The post collar, pipe flange, bolts, nuts and washers shall conform to the details of the Drawings.

9-33.8 BACK GUY ASSEMBLIES

Unless otherwise indicated in the Contract, guy wire shall be 5/16 inch, aluminum covered steel strand wire.

Guy assembly components including the deadend grips, the porcelain strain insulator, and the automatic feed-thru deadend shall be sized so as to meet or exceed the rated breaking strength of guy wire.

Anchors for back guys shall consist of one of the following types:

1. A 4-way or 8-way steel expanding anchor, having a minimum of 300 square inches, made of pressed steel, coated with asphalt or similar preservative and fitted with 3/4 inch minimum guy eye anchor rod 8 feet long.
2. Plate anchor fitted with 3/4 inch minimum guy eye anchor rod 8 feet long.
3. An approved steel screw, such as a power installed steel helix anchor with extension rods, extension rod coupling, and strand eye nut. The steel screw shall be sized based upon its load and soil conditions by the Engineer.

The following components shall conform with the requirements of SCL Material Standards:

Component	SCL Material Standard
Guy Wire	5664.1
Guy Hook with Integral Spurs	5651.15
Deadend Grip	5651.4
Porcelain Strain Insulator	6901.1
Plastic Wire Guard	5651.8
Automatic Feed-thru Deadend	5650.3
Plate Anchor	5620.7
Single Strand Eye Nut	5652.1
Guy Pipe Clamp	5601.1

The pipe brace shall be galvanized extra strong steel pipe.

SECTION 9-34 ELECTRICAL AND SIGNAL CONDUITS

9-34.1 GENERAL

Conduit shall be PVC coated galvanized rigid steel, galvanized rigid steel, or schedule 80 PVC conforming to Articles 346 (rigid metal conduit) or 347 (rigid nonmetal conduit) of the NEC type and size as indicated on the Drawings. All conduit, elbows, fittings, and accessories shall be UL listed.

Factory bends and elbows shall be utilized in all cases where they provide the required deflection.

Field bends, when required, shall be performed so as to result in no flattening of conduit or damage to the galvanizing or PVC coating.

9-34.2 RIGID STEEL CONDUIT

9-34.2(1) GENERAL

Exterior and interior surfaces of all steel conduit, including threads, except field cut threads, shall be uniformly and adequately zinc coated by a hot dip galvanizing process. The average weight of zinc coating shall not be less than 0.80 ounces of zinc per square foot of single surface area as determined by tests on 12 inch samples taken from a standard length of conduit of each size. The weight of zinc coating on any individual test specimen shall be not less than 0.7 ounces of zinc per square foot of single surface area. The weight of zinc coating will be determined in accordance with AASHTO T 65. Determinations and nominal weights shall conform to the requirements of the Underwriters Laboratory Publication No. 6 (current edition). In addition, the exterior as well as the interior conduit samples shall withstand 4 dips in the PREECE test in accordance with ASTM A 239.

Every length of rigid metal conduit shall bear the label of Underwriters Laboratories, Inc., or the label of the Canadian Standards Association, if affected items of Canadian manufacture are approved for use on the Project *as indicated in the Contract*. Installation shall conform to appropriate articles of the NEC.

Rigid steel conduit may be substituted where PVC is indicated on the Drawings at the Contractor's option when approved by the Engineer at no additional expense to the Owner, except on pole risers.

Fittings for field and factory bends shall be identical and interchangeable.

9-34.2(2) THREADS

The exposed thread ends of rigid steel conduit shall be hot dipped galvanized in accordance with the foregoing. Field cut threads shall be painted with galvanized repair paint acceptable to the Engineer.

9-34.2(3) COUPLINGS AND FITTINGS

Couplings and fittings for rigid steel type conduits shall be hot-dip galvanized, with the same quantities of zinc noted above. Couplings shall withstand 4 dips in the PREECE test as specified above.

9-34.2(4) PVC COATING

All galvanized rigid steel conduit shall be PVC (polyvinyl chloride) coated with dark gray, and U.V. resistant type plastic where indicated on the Drawings.

The zinc surface prior to plastic coating shall be conditioned with chromic acid to provide an anchor for the plastic coating.

Both interior and exterior shall be coated with an epoxy acrylic primer not to exceed 0.0005 inches thick prior to the application of the PVC coating.

A PVC coating shall be bonded to the outside of the pipe (excluding the threads) with a thickness between 0.035 inch and 0.045 inch. The PVC coating shall be applied by the plastisol dip method and shall contain ultraviolet inhibitors.

A urethane coating of a nominal 2 mil thickness shall be applied to the interior of all conduits.

A coupling with the same PVC coating shall be furnished loose with each length of conduit and shall have a plastic sleeve extending 1 pipe diameter or 2 inches (whichever is less) beyond the end of the coupling. The inside diameter of the plastic sleeve shall be the same as the outside diameter of uncoated pipe of the same nominal size. The wall thickness of the plastic sleeve shall be the same as the plastic coating on the pipe. The bond between the metal and the PVC coating shall be equal to or greater than the tensile strength of the PVC coating.

All conduit fittings which are hollow and serve as part of the raceway shall be coated with the same coatings on the outside and inside as described above. The fittings shall have PVC sleeves at all female openings similar to the sleeves on the couplings. The coated conduit shall conform to NEMA Standard No. RNI-1974 (Type A).

All coated conduit brackets, supports, clamps, NEMA 4 junction boxes, drains, breathers, expansion/deflection fittings, seals, etc., shall be PVC coated by the producer of the conduit. Field repair and touch-up shall be made with Materials approved by the Engineer.

9-34.2(5) RESERVED

9-34.2(6) EXPANSION/DEFLECTION FITTINGS IN NON-HAZARD AREAS

Expansion/deflection fittings shall be installed in all structural expansion joints. The expansion portion of the set shall provide for 4 inches of movement, 2 inches in each direction, unless specified otherwise on the Drawings. The deflection portion of the set shall provide for a movement of 3/4 inch in all directions, and an angular deflection of 30 degrees from normal in any direction. Fittings shall be O.Z. Gedney Type AXDX or approved equal.

9-34.3 PVC CONDUIT

Plastic conduit and fittings shall be rigid PVC Type EPC schedule 80.

PVC rigid non-metallic conduit may be used for all installations except the first 10 feet above ground on a pole riser and the adjacent bend, unless specified otherwise in the Contract.

Rigid PVC shall meet the requirements of ASTM D 1785 and ASTM D 2466. The conduit shall be suitable for use above ground, for direct burial, and for corrosive atmosphere areas.

9-34.4 CONDUIT RISER

Refer to Section 8-33.3(3).

9-34.5 PULL CORD

Pull cords shall be 1/4 inch polypropylene meeting the requirements of Seattle City Light Material Standard 7272.2.

9-34.6 HANDHOLES

Handholes shall be precast concrete, reinforced, and of the type and size indicated on *Standard Plan no. 550*. Handholes shall have covers with a slide-lock device, non-skid surface and a ground strap. Covers shall be 5/16 inch thick steel having a 3-way raised pattern, and shall be hot-dip galvanized in accordance with ASTM A 123. Covers shall be identified with 3 inch high letters "TC" clearly visible on the top where *Traffic* control cables occupy the handhole or "SL" where the handhole is used by street lighting only. The marking shall be accomplished by welding or shall be cast onto the cover.

The non-skid surface shall be made of slip resistant steel plate and be 5/16 inch in thickness. Approved plates are Mebac 1 (their most aggressive surface) as manufactured by IKG Industries, or steel SlipNOT Grade 3-coarse as manufactured by W.S. Molnar Co., or approved equal.

The cover shall be identified with permanent marking on the underside with the type of surface ("M1" for Mebac 1; or "S3" for SlipNOT 3; or similar marking for approved equal), and the year of manufacture. The permanent marking shall be clear, and may be bead-welded at the Contractor's option.

SECTION 9-35 ELASTOMERIC BEARING PADS

Elastomeric bearing pads shall conform to the requirements of AASHTO M 251. The elastomer shall not contain any form of wax.

All bearing pads shall be individually cast with fully molded edges. Corners and edges of molded pads may be rounded at the option of the Contractor. Radius at corners shall not exceed 3/8 inch, and radius of edges shall not exceed 1/8 inch.

Shims contained in laminated bearing pads shall be mill rolled steel sheets not less than 20 gage in thickness with a minimum cover of elastomer on all edges of:

- 1/8 inch for pads up to 3 inches thick, and
- 1/4 inch for pads over 3 inches thick.

The shims shall be spaced to divide the pad thickness into equal laminations. The bond between the elastomer and metal shims shall be such that, when a sample is tested for separation, failure shall occur within the elastomer and not between the elastomer and the metal shim.

The grade or durometer hardness of the bearing pads shall be as noted in the Contract.

Elastomeric bearing pads shall be manufactured with the following tolerances:

Overall vertical dimensions:	
Design thickness 1 1/4 inches or less	-0, + 1/8 inch
Design thickness over 1 1/4 inches	-0, + 1/4 inch
Overall horizontal dimensions:	
36 inches and less	-0, + 1/4 inch
Over 36 inches	-0, + 1/2 inch

2003 City of Seattle Standard Specifications for Road, Bridge, and Municipal Construction

INDEX

A

Abandon catch basin, valve chamber, manhole or inlet	2-02.3(4)
Abandon and fill, and plug pipe	2-02.3(5)
Abbreviations, associations and miscellaneous	1-01.2(1)
Abbreviations, items of work and units of measurement	1-01.2(2)
Abbreviations, standard - see Standard Plan No. 002	
Abbreviations, standard symbols - see Standard Plan No. 003	
Acceptance - see "Completion dates" and "Final inspection"	
Access to private property during construction	1-07.24
Access to work (inspection)	1-05.6
Addenda	1-02.6
Adjusting utility and similar structures to grade	7-20
Admixtures for concrete - see "Concrete structures"	
Aggregates	9-03
asphalt concrete pavement	5-04.3(7), 9-03.8
concrete structures	6-02.3(2)
cushion for permanent erosion control geotextile	9-05.22(3)
mineral aggregate chart	9-03.16
test methods for	9-03.15
Air entrainment	
admixture	9-23.6
concrete pavement	5-05.3(1)
concrete structures	6-02.3(3)A
Air release/ air vacuum valves, water	9-30.3(7)
Air relief valve, irrigation	9-15.7(9)
Alignment and camber	
concrete girder deflection	6-02.3(25)L
railings, metal	6-06.3(2)
steel structures	6-03.3(31)
Alley, blocking of – construction notification requirement	1-07.28
Alley return – see "Concrete driveway"	
Aluminum pipe in contact with portland cement, treatment for	7-02.3(1)C3b
Aluminum steps, manhole	9-12.2(2)
Amendments, landscaping	9-14.4
American-made material requirements - see section 1-06.5 of the project manual	
Anchor bolts	
grout for	6-02.3(20), 9-04.3(2)B
placed in concrete structure	6-02.3(18)
placed in steel structure	6-03.3(35)
poles and pedestals, lighting and signal	9-33.1(2)
structural steel	9-06.5(4)
Anti-stripping additive	9-02.4
Appeals (protest of an intended award of contract)	1-03.7
Approval of	
materials	1-05.6, 1-06.2
shop drawings	1-05.3
source of materials	1-06.1
"Approved equal, or"	1-06.1
Arch pipe, structural plate	7-03
As-built records	1-05.3(4)
Asphalt	
bituminous materials	9-02
bituminous surface treatment	5-02
construction requirements for pavement, driveway	5-04.3
pavement reclamation	4-07
pavement recycling	4-05
waterproofing	6-08.3(3), 9-11.1
Asphalt concrete - see "Pavement, asphalt concrete"	
Asphalt treated base (ATB)	4-06
Assignment	1-08.2
Assistant	
authority	1-05.2
defined term	1-01.3
Associations and miscellaneous	1-01.2(1)
ATB (asphalt treated base)	4-06
Audits of contractor records	1-09.12
Authority of contractor's superintendent or project manager	1-05.13
Authority of assistants	1-05.2
Authority of engineer	1-05.1
Award and execution of contract	1-03

2003 City of Seattle Standard Specifications for Road, Bridge, and Municipal Construction

B

Backfill	
CDF, pipe bedding & trench backfill	9-01.5
mineral aggregates	9-03
selected material	2-03.3(10)
Backfilling	
embankment construction	2-03.3(14)
flow control system	7-16.3(1)
irrigation system	8-03.3(11)
sewer and drainage structures	7-05.3(1)O
structure excavation	2-09.3(1)E
structural plate pipe, arch, and underpass	7-03.3(3)
trench, culvert	7-02.3(3)
trench, miscellaneous pipe connection	7-08.3(1)
trench, sewer	7-17.3(3)
trench, side sewer	7-18.3(2)
trench, water main	7-10.3(10)
Backflow prevention devices, water	9-30.16
Backflow prevention devices, irrigation	9-15.9
Backflow prevention requirement	7-11.3(12)G
Back guy assembly	8-32.3(3), 9-33.8
Ballast for riprap	8-15.2
Ballasting and crushed surfacing	4-04
Ballasts, electrical	
overhead interior illuminated signs	9-32.7
luminaires	9-31.1
Bark mulch	9-14.4(3)
Barricades	
construction under traffic	1-07.23(1)
pedestrian control and protection	1-07.23(2)
traffic control plans	1-10.2(5)
Barrier, concrete	6-10
Base	
asphalt treated	4-06
ballasting and crushed surfacing	4-04
manholes	7-05.3(1)E
Beam guardrail	
construction	8-11
non-weathering steel	9-16.3
weathering steel	9-16.8
Bearing pad, elastomeric	9-35
Bearing test, 3 edge - for concrete pipe	9-05.3(2)C
Bearing value	
falsework piling	6-02.3(17)E
piles, determination of	6-05.3(12)
Bearings, bridge	6-02.3(19)
Bedding for pipe	
sewer and drainage	7-17.3(1)B
water main	7-10.3(6)
Beginning work (notice to proceed)	1-08.4
Benches	8-02.3(20), 9-14.13
Bending reinforcing steel	6-02.3(24)B, 9-07.1(2)
Bid(s)	
appeals	1-03.7
defined term	1-01.3
documents, where to obtain	1-02.2
consideration of	1-03.1
form (defined term)	1-01.3
form and style of	1-02.5
guaranty	1-02.7
guaranty (defined term)	1-01.3
irregular	1-02.13
modification or withdrawal	1-02.10
public opening	1-02.12
procedures and conditions	1-02
return of guaranty	1-03.6
submittal	1-02.9
tabulation	1-03.1(2)
withdrawal or modification	1-02.10
Bidder	
defined term	1-01.3
disqualifications	1-02.14
qualifications	1-02.1
Bituminous materials	9-02
Bituminous surface treatment	5-02
Block traffic curb	8-07, 9-18.3

2003 City of Seattle Standard Specifications for Road, Bridge, and Municipal Construction

Blocking alley, street, sidewalk – construction notification requirement	1-07.28
Blowoff assembly (water main)	7-11.3(14), 9-30.2(10)
Bollards	8-02.3(19), 9-14.12
Bolt holes -see "Holes"	
Bolted connections	
falsework & formwork, timber	6-02.3(17)J
preparation for steel structures	6-03.3(27)G
steel structures	6-03.3(33)
Bond	
bid guaranty	1-02.7
bid guaranty, defined term	1-01.3
contract bond	1-03.4
contract bond, defined term	1-01.3
Bonding and grounding	
illumination & electrical	8-30.3(7)
traffic signal system	8-31.3(10)
Borrow	
classification	2-03.3(13)
gravel	9-03.14
sites, disposal and	2-01.2
Bracket arm	8-32.3(5), 9-33.2(9)
Bridge approach slab, reinforced concrete	5-05.3(19)
Bridge drains	6-02.3(36)
Bridge drains, maintenance during construction	6-01.16
Bridge drawings, normal temperature	6-01.5
Bridge railings	6-06
Bridge under construction, load restrictions	6-01.6
Bus shelter footing	8-14.3(9)
Bus zone signs	8-21.3(1)B
Buttons, traffic	8-08, 9-21
"Buy American" requirements - see section 1-06.5 of the project manual	

C

Cable outlets on poles	9-33.2(5)
Calcium chloride in concrete admixtures	9-23.6
Calcium chloride in non-shrink cement sand grout	9-04.3(2)C
Calcium chloride in concrete pavement	5-05.2
Castings	
adjustment in pavement	7-20
sewer and drainage	7-05.3(1)R, 9-05, 9-12
survey monuments	9-22
water main	9-30.3(12)H
Catch basins	7-05.3(2), 9-12
CDF – see "Controlled density fill"	
Cement	
admixtures	9-23
CDF – see "Controlled density fill"	
classification of concrete for pavements	5-05.3(1)
classification of concrete for structures	6-02.3(2)A
portland cement	9-01
slurry, abandon and fill pipe	2-02.3(5)A, 9-05.23
slurry, annular space between pipes	7-17.3(2)J, 9-05.23
Cement concrete approaches	5.05.3(18)
Cement concrete in contact with aluminum pipe, treatment of	7-02.3(1)C3b
Cement concrete pavement - see "Pavement, cement concrete"	
Cement concrete structural – see "Concrete structures"	
Cement concrete sidewalks	8-14
Cement slurry for abandoning pipe and filling annular space between pipes – see "Cement"	
Chain link fence and wire fence	8-12
Changed conditions – see "Differing site conditions"	
Changes, equitable adjustment for	1-09.4
Changes in contract	1-04.4
Channel excavation	2-10
Chemical spill	
notification requirement	1-07.28
water quality	1-07.5(2)
Chloride	
in concrete admixtures	9-23.6
in prestressed concrete	9-19.1
in structural concrete	6-02.3(2)A
in structural concrete placed underwater	6-02.3(3)B
in structural grout	6-02.3(26)G
in water for concrete	9-25.1
ion content in precast prestressed concrete	9-23.7
Claims and dispute resolution process	1-04.5(2)
Class concrete – see "Cement"	

2003 City of Seattle Standard Specifications for Road, Bridge, and Municipal Construction

Cleanup	
final and roadside	1-04.11
quarry and pit sites	3-01.2(1)E
Cleaning existing drainage structures	7-07
Clear plastic covering, erosion control	8-01.3(8), 9-14.5(3)
Clearances with utilities	1-07.17(2)
Clearing, grubbing, and roadside cleanup	2-01
Clearing, site for structures	6-01.3
Coal tar pitch emulsion	9-02.1(9)
Cofferdams	2-09.3(3)
Cold weather work/unfavorable weather - see "Weather limitations"	
Collusion	1-02.8
Coloring agent for concrete sidewalk	8-14.2, 9-23.10
Combined sewers	
connections with culverts	7-02.3(2)
pipes and connections	7-18.3(7)A
Compacting	
asphalt concrete	5-04.3(10)
asphalt treated base	4-06.3(9)
ballasting and surfacing	4-04.3(5)
backfill, culvert	7-02.3(3)
backfill, sewer & drainage structures	7-05.3(1)O
backfill, electrical conduit	8-33.3(1)
backfill, flow control structure	7-16.3(1)
backfill, sewer and drainage	7-17.3(3)
backfill, water main	7-10.3(11)
concrete for pavement	5-05.3(7)
earth embankments	2-03.3(14)D
erosion control	8-01.3(1)B
full depth asphalt pavement recycling	4-05.3(2)C
full depth pavement reclamation	4-07.3(2)D
lawn installation	8-02.3(14)A
planting area preparation	8-02.3(4)
rock embankments	2-03.3(14)B
structure excavations	2-09.3(1)E
subgrade	2-06
Compaction control tests	2-03.3(14)E
Completion, contract	1-05.12
Completion date - defined terms	
completion	1-01.3
contract completion	1-01.3
physical completion	1-01.3
substantial completion	1-01.3
Completion, time for	1-08.5
also see agreement form in the project manual	
Concrete - see "Concrete structures" or "Pavement, cement concrete"	
Concrete barrier	6-10
Concrete brick	
sewer & drainage structures	9-12.6
valve chambers	9-30.3(12)C
Concrete, cement – see "Cement"	
Concrete curing materials and admixtures	9-23
Concrete driveway	8-19
Concrete in contact with aluminum pipe, treatment	7-02.3(1)C3b
Concrete pipe	
permeability test	9-05.7(1)A
three edge bearing test	9-05.3(2)C
Concrete slope protection	8-16
Concrete structures	6-02
admixtures	6-02.3(3), 9-23
air entrained concrete	6-02.3(3)A
bonding new concrete to existing	6-02.3(34)A2
class concrete	6-02.3(1)
compression seal	6-02.3(13)
concrete mixes	6-02.3(2)A
concrete mixing requirements	6-02.3(4)
concrete placing requirements	6-02.3(6)
construction joint	6-02.3(12)
crack, epoxy injection of	6-02.3(33)
curing	6-02.3 (11)
curing materials	9-23
drilling holes in	6-02.3(30)
expansion joint	6-02.3(13)
exposed to alkaline soils or water	6-02.3(8)
exposed to seawater	6-02.3(7)
finishing surfaces (Class finish)	6-02.3(14)
fly ash	9-23.9

2003 City of Seattle Standard Specifications for Road, Bridge, and Municipal Construction

formwork and falsework	6-02.3(17)
formwork and falsework removal	6-02.3(17)O
precast panels	6-02.3(28)
prestressed girders	6-02.3(25), 9-19
rate of placing, concrete pressure	6-02.3(17)K
repair of spalled and delaminated	6-02.3(32)
retempering	6-02.3(4)D
roadway slabs	6-02.3(10)
slump (consistency)	6-02.3(4)E
vibration	6-02.3(9)
weather and temperature limits to protect	6-02.3(6)B
Conduit and trenching, electrical	8-33
risers	8-33.3(3)
jacking or boring	8-33.3(5)
rigid steel	9-34.2
PVC	9-34.3
Conformity with and deviations from drawings and stakes	1-05.4
Connection, catch basin, inlet and drop	7-08
Construction joint, concrete structures	6-02.3(12)
Construction near Seattle Monorail – notification requirement	1-07.28
Construction notification requirements	1-07.28
Construction stakes	1-05.5
Contaminant spill – notification requirement	1-07.28
Contract	
assignment	1-08.2
award of	1-03.2
bond	1-03.4
bond (defined term)	1-01.3
change in	1-04.4
completion	1-05.12
completion date (defined term)	1-01.3
coordination of documents	1-04.2
defined term	1-01.3
execution of	1-03.3
extension of time and delays	1-08.8
failure to execute	1-03.5
final inspection	1-05.11(2)
intent of	1-04.1
liquidated damages, overrun of contract time	1-08.9
physical completion	1-05.11(2)
physical completion date (defined term)	1-01.3
subcontracting	1-08.1(3)
substantial completion	1-05.11(1)
substantial completion date (defined term)	1-01.3
termination	1-08.10
time (defined term)	1-01.3
working days, time for completion	1-08.5
Contract bond	1-03.4
Contract bond, defined term	1-01.3
Contract price	
awarded (defined term)	1-01.3
final (defined term)	1-01.3
revised (defined term)	1-01.3
Contraction joints	
concrete driveway	8-19.3(3)
concrete pavement	5-05.3(8)B
concrete sidewalk	8-14.3(6)
joint sealants for sawed	9-04.2(1)
Contractor	
compliance with law	1-07
construction activities, notification requirements	1-07.28
cooperation with other contractors	1-05.14
defective and unauthorized work	1-05.7
defined term	1-01.3
examination of bid documents and project site	1-02.4
patented devices, materials, and processes	1-07.20
load limits	1-07.7
prevailing wages	1-07.9
responsibility for work and damages	1-07.13
submittals	1-08.3
unauthorized work	1-05.7
Contractor performance evaluation program	1-05.13(2)
Controlled blasting (see special provisions in the project manual)	
Controlled density fill (CDF)	
CDF pipe bedding	9-01.5
CDF structural bedding	2-09.3(1)E
CDF trench backfill	9-01.5

2003 City of Seattle Standard Specifications for Road, Bridge, and Municipal Construction

see "Cement, slurry" for filling abandoned pipe and for filling annular space between 2 pipes

Control of materials	1-06
Control of work	1-05
Controller	
irrigation, automatic	9-15.4
irrigation, installation	8-03.3(7)
irrigation, electrical wire	9-15.6
irrigation, flushing & testing	8-03.3(9)
traffic signal, assembly	8-31.3(2)
traffic signal, assembly replacement	8-31.3(1)C
traffic signal, assembly testing	8-31.1(5)
traffic signal, check-out & turn-on procedures	8-31.3(1)
traffic signal, check-out procedure	8-31.3(15)
traffic signal, detector loops to	9-32.6
traffic signal, final inspection & as-built drawings	8-31.3(17)
traffic signal, foundations	8-32.3(2)B
traffic signal, turn-on / cut-over procedure	8-31.3(16)
Coordination of contract components	1-04.2
Copper seals	9-06.13
Corrosion protection, water main	
coating for bolts and shackle rods	9-30.15
couplings	9-30.2(7)
electrolysis test station	9-30.12
pipe coatings	9-30.1(6)
Corrosion resistant material	
aluminum poles	9-33.3
ground rods, clamps, and hardware, electrical	9-31.7
pedestrian signal heads, case	9-32.4(3)
water main fittings, bolts and nuts	9-30.2(7)
Corrugated	
drain installation	7-01.3
flow control systems, limitations	7-16.2
manholes	7-05.3(1)L, 9-12.10
sewer and drainage piping	9-05
cut-in tee to pipe connection	7-17.3(2)C3
Counter, batch, concrete	5-05.3(3), 6-02.3(4)C
Cover, depth of	
electrical & signal conduit	8-33.3(1)
watermain, distribution	7-10.3(5)C
Crack repair, concrete structure	6-02.3(33)
Crack sealing, asphalt	5-04.3(5)D
Cribbing, gabion	6-09, 9-27
Critical path schedule	1-08.3(1)
Crushed surfacing	4-04, 9-03.9
Cultivation	
erosion control	8-01.3(1)A
landscaping	8-02.3
Culverts	7-02
Curb	
and gutter, type 410 B	8-04.3(4)
blockouts at curb ramps	8-04.3(2)
cement concrete	8-04
doweled, type 410C	8-04.3(5)
extruded, asphalt & cement concrete	8-06
mountable, for traffic circles	8-04.3(6)
placed with concrete sidewalk	8-14
precast, traffic & block	8-07
ramps, types 1 and 2	8-14.3 (7) and (8)
Curb wall	5-05.3(23)D
Curing	
concrete curb	8-04.3(1)E
concrete driveway	8-19.3(4)
concrete extruded curb	8-06.3(6)
concrete manhole	7-05.3(1)D2
concrete pavement	5-05.3(13)
concrete piles	6-05.3(3)D
concrete precast panels	6-02.3(28)D
concrete prestressed girders	6-02.3(25)E
concrete sidewalks	8-14.3(5)
concrete slope protection	8-16.3(3) and (4)
concrete stairways, landing, and steps	8-18.3(5)
concrete structures	6-02.3(11)
concrete structures, removal of falsework and forms	6-02.3(17)O
curing materials	9-23
full depth pavement reclamation	4-07.392)D
traffic curb, precast & block	9-18.1(6)

2003 City of Seattle Standard Specifications for Road, Bridge, and Municipal Construction

D

Damage, contractor responsible for work and	1-07.13
Damages, liquidated	1-08.9
Damages, liquidated (defined term)	1-01.3
Date numerals, for concrete structures	6-02.3(15)
Dates	
application of seed, fertilizer, mulch – erosion control	8-01.3(7)
landscape planting	8-02.3(6)A
contract, various, defined terms	1-01.3
Day - defined terms – business, calendar, non-working, working, unworkable	1-01.3
Debris, clearing and grubbing, disposal of	2-01.2
Decomposed organic mulch amendment	9-14.4(5)
Defective and unauthorized work	1-05.7
Defined terms, contract	1-01.3
Definitions, electrical and electronic words and phrases	1-01.3
Definitions and tests, materials	9-00
Delaminated and spalled structural concrete, repair	6-02.3(32)
Delays, contract time	1-08.8
Deleted or terminated work	1-09.5
Delineator posts, flexible	8-10
Density,	
ATB	4-06.3(7)
asphalt concrete	5-04.3(10)B
compaction control tests, soils	2-03.3(14)E
full depth asphalt pavement recycling	4-05.3(2)C
full depth pavement reclamation	4-07.3(2)D
trench backfill, sewer / drainage & related structure excavation	7-17.3(3)B
trench backfill, water main & related structure excavation	7-10.3(10)
Detectable marking tape, irrigation system	9-15.11
Detector loops	8-31.3(5), 9-32.6
Detention pipe	7-16.3(3)
Detention systems in environmentally critical areas	7-16.2
Detention storage – see "Flow control structures"	
Dewatering	
casing for cast-in-place concrete piles	6-05.3(15)B
concrete seals & foundations	6-02.3(6)D
sewer & drainage pipe excavation	7-17.3(1)A3
sewer & drainage structure excavation	7-05.3(1)A1
structure excavation	2-09.3(3)F
water main excavation	7-10.3(7)C
water main excavation, during water main pipe installation	7-11.3(1)
Differing site conditions	1-04.7
Disputes and Claims Resolution Process	1-04.5
Disposal of	
borrow and disposal sites	2-01.2
structure excavation	2-09.3(1)D
surplus materials	2-03.3(7)
Disqualification of bidders	1-02.14
Ditch and Channel Excavation	2-10
Ditches, roadway	2-03.3(9)
Dowel bars	
concrete pavement	5-05.3(10), 9-07.5
curb construction	8-04.3(1)C
timber structures	6-04.3(5)
Downspouts	
concrete structures	6-02.3(29)
side sewer testing	7-18.3(6)B
Drainage	
of box girder cells	6-02.3(21)
of substructure	6-02.3(22)
underground, geotextile	2-12.3(2)
Drainage structures	
cleaning existing	7-07
removal of	2-02.3(2)
salvage of	2-02.3(7)F
Drains	
bridge, construction of	6-02.3(36)
bridge, maintenance of	6-01.16
storm - see "Storm drain and sanitary sewer"	
subsurface	7-01
Drawings	
as-built	1-05.3(4)
contract, contractor responsibility	1-05.3
defined term	1-01.3
also see "Shop drawings"	
Driveway	

2003 City of Seattle Standard Specifications for Road, Bridge, and Municipal Construction

asphalt concrete	5-04.3(15)
cement concrete	8-19
Drop connections	7-08.3(6)
Ductile iron castings	9-06.14
Dust ratio	
definition	9-00.5
mineral aggregate type requirements	9-03

E

Earth embankments	2-03.3(14)
Ecology block, concrete	Standard Plan no. 460
Edging	
cedar, landscape construction	8-02.3(18)
cedar material	9-14.11
paver restraint block construction	8-02.3(18)B
paver restraint block material	9-14.9(14)
Elastomeric bearing pads	6-02.3(19)A, 9-35
Elastomeric expansion joint seal, concrete pavement	9-04.1(4)
Elastomeric flexible seals for PVC pipe	9-04.8
Electrical, applicable codes	8-30.1(2)
Electrical and electronic words and phrases	1-01.3
Electrical safety observer	
authority of	1-05.2(2)
defined term	1-01.3
construction notification requirement	1-07.28
Electrical wire, irrigation system	9-15.6
Electrical wire and controller installation, irrigation system	8-03.3(7)
Electrical vaults – construction notification requirement	1-07.28
Embankments	
bridge approach (defined term)	1-01.3
construction of	2-03.3(14)C
stepped slope construction	2-03.3(18)
Emulsified asphalt, cationic	
application, bituminous surface treatment	5-02.3(3)
material specification	9-02.1(6)
Engineer	
authority of	1-05.1
defined term	1-01.3
Entry onto private property – see "Private property"	
Epoxy Resins	9-26
anchoring bars and rods to concrete	6-02.3(31)
material properties	9-26
patching, coated rebar for structural concrete	6-02.3(24)I
structural concrete crack repair	6-02.3(33)
Equal Employment Opportunity and non-discrimination requirements	1-07.11
Equipment	
asphalt hauling	5-04.3(2)
asphalt pavement construction	5-04.3(4)
ballasting and crushed surfacing	4-04.3(1)
bituminous surface treatment	5-02.3(1)
contractor's machinery and	1-05.9
concrete pavement construction	5-05.3(3)
contractor's, defined term	1-01.3
extruded curb construction	8-06.3(3)
full depth asphalt pavement recycling	4-05.3(1)
full depth pavement reclamation	4-07.3(1)
pile driving	6-05.3(9)
subsealing	5-01.3(2)
superintendent, labor, and	1-05.13
weighing	1-09.2
Erosion Control and Roadside Planting (materials)	9-14
Erosion Control	8-01
Erosion and water pollution control, temporary	1-07.15
Error, claim of, bid	1-03.1(3)
Estimates	
progress payment	1-09.9(1)
material on hand, progress payment for	1-09.8
Ethafoam (plastic foam)	9-05.14
Examination of bid documents and project site	1-02.4
Excavation	
classification – common, unsuitable foundation, solid rock	2-03.1(2)
ditch and channel	2-10
roadway	2-03
safety systems, trench	7-17.3(1)A7a
stripping pits and quarries	3-01
structure	2-09

2003 City of Seattle Standard Specifications for Road, Bridge, and Municipal Construction

trench, sewer and drainage	7-17.3(1)A
trench, water main	7-10.3(7)
Execution of contract	1-03.3
Existing drainage structures, cleaning	7-07
Expansion joint filler and sealer	9-04.1 and 2
concrete bridge roadway slabs	6-02.3(13)
concrete pavement	5-05.3(8)C1
material, concrete pavement	9-04.1(2)
material, structural concrete	6-01.14
Expansion bearings	
concrete structures	6-02.3(19)B
steel structures	6-03.3(37)
Explosives, use of	1-07.22
Extension of contract time	1-08.8
Execution of contract	1-03.3
Execution of contract, failure to	1-03.5
Eyebars, steel	6-03.3(22)

F

Fabric, waterproofing	6-08
Falsework and formwork	
concrete structure construction	6-02.3(17)
concrete structure shop drawing requirements	6-02.3(16)
concrete structure, removal of	6-02.3(17)O
steel structure construction	6-03.3(12)
Fence	
chain link and wire, construction	8-12
materials	9-16
Fertile mulch amendment	9-14.4(4)
Fertilizer	
application, erosion control	8-01.3(4)B
application, landscaping	8-02.3(8)B
material specifications	9-14.3(1)
Festoon outlet	9-33.2(5)
Field office for engineer's staff - see Section 1-07.29 of the project manual	
Field tests	
backfill compaction control	2-03.3(14)E
bolted connections, steel structures	6-03.3(33)
concrete pavement smoothness	5-05.3(12)
flow control systems	7-16.3(5)
gabion unit weight	6-09.3(6)F
illumination and electrical	8-30.3(9)
irrigation system	8-03.3(9)
piles	6-05.3(10)
sewer and storm drain	7-17.3(4)
traffic signal system	8-31.3(15)
water main, final flush and	7-11.3(12)L
water main, hydrostatic pressure	7-11.3(11)
water main, taste and odor	7-11.2(2), 7-11.2(3)
welding rebar	6-02.3(24)F
welds, structural steel	6-03.3(25)B
Filter blanket for riprap	8-15.3(7)
Filter fabric – see "Geotextile"	
Filter material behind rock facing	8-08.3(1)E
Final cleanup	
roadside and	1-04.11
quarry and pit site reclamation	3-01.3(1)E
structures	6-01.12
Final inspection	1-05.11
Final payment for contract	1-09.9(4)
Finishes, concrete structure surfaces, classes 1, 2, and 3	6-02.3(14)
Finishing	
asphalt concrete pavement	5-04.3(9)
asphalt treated base (ATB)	4-06.3(6)
bridge roadway slabs	6-02.3(10)
cement concrete pavement	5-05.3(11)
concrete curb	8-04.3(1)D
concrete driveway	8-19.3(3)
concrete piles	6-05.3(3)C
concrete sidewalk	8-14.3(4)
concrete stairways, landings, and steps	8-18.3(5)
concrete traffic and pedestrian barrier	6-02.3(11)B
monolithic curb and sidewalk	8-14.3(11)
presact concrete panels	6-02.3(28)F
prestressed concrete girders	6-02.3(25)I
steel structural member edge finishing	6-03.3(14)

2003 City of Seattle Standard Specifications for Road, Bridge, and Municipal Construction

steel structural members	6-03.3(11)
Flexible guide posts	9-17
Flexible delineator posts	8-10
Floor, timber	
laminated	6-04.3(15)
single plank	6-04.3(14)
subfloor for concrete deck	6-04.3(16)
Flow control structure	9-05.19
Flow control systems	7-16
Flow control systems in environmentally critical areas	7-16.2
Flow control systems to be owned or maintained by the City	7-16.2
Follower, pile driving	
allowed uses	6-05.3(11)E
definition	6-05.3(1)
Force account	1-09.6
Force mains, sanitary sewer, hydrostatic test	7-17.3(4)F
Forgings, steel	
material	9-06.11
steel structures, used in	6-03.3(43)
Formwork	
concrete pavement, side forms	5-05.3(21)
shop drawings for concrete structures	6-02.3(16)
structural systems and falsework	6-02.3(17)
Formulas for	
carbon content, rebar suitable for welding	6-02.3(24)F
hankinson formula, bolted timber connections	6-02.3(17)J
leakage test, sanitary force main	7-17.3(4)F7
paints	9-08.2
pile driving, ultimate bearing	6-05.3(12)
pile driving vibrations, distance limitation	6-05.3(11)H
Foundations and preparation of	
cribbing, gabion	6-09.3(1)A
culvert	7-02.3(1)A
data for structures	6-01.2
sewer and drainage structures	7-05.3(1)B
flow control systems	7-16.3(1)
miscellaneous pipe connections	7-08.3(1)
pavement subgrade	2-06
pile driving, ultimate bearing	6-05.3(12)
pole, pedestal, pedestrian pushbutton post, & signal controller	8-32.3(2)
riprap	9-08.2
sewer & drainage pipe	7-17.3(1)
side sewer	7-18.3(2)
structural plate pipe, pipe arch, arch & underpass	7-03.3(1)
subsurface information	1-02.4(2)
water mains	7-10.3(7)
Fracture, aggregate (definition)	9-00.1
Frame and cover – see "Castings"	

G

Gabion cribbing	6-09.3(6), 9-27.3
Gaskets, pipe joint material	
flexible plastic gaskets	9-04.5
rubber gaskets	9-04.4
Gates, chain link & wire fence	8-12, 9-16
Geotextile	2-12, 9-05.22
Girders	
prestressed concrete	6-02.3(25)
steel plate	6-03.3(21)
Glare screen	8-25, 9-16.6
Gradations, mineral aggregate types	9-03
Grade adjustment, castings	
adjust to finished grade	7-20
hydrants	7-14.1
new catch basin	7-05.3(2)C
new inlet	7-05.3(2)D
new manhole	7-05.3(1)P
new water main	7-12.3(3)
Grade requirements, timber and lumber	9-09.2
Grates – see "Castings"	
Gratuities	1-07.19
Gravel backfill	9-03
Gravel borrow	2-03.3(14)K, 9-03.14
Ground rods and clamps, electrical	9-31.7
Grounding and bonding, illumination and electrical	8-30.3(7)
Grounding and bonding, traffic signal	8-31.3(10)

2003 City of Seattle Standard Specifications for Road, Bridge, and Municipal Construction

Grout – also see "Mortar" and "Epoxy resin"

Grout, non-shrink cement applications	
cut-in tee on sewer pipe	7-17.3(2)C3
deck bulb tee girder, placing	6-02.3(25)P
electrical conduit – structure connection	8-33.3(2)A
flow control structures	7-16.3(2)
handrail mounting	8-18.3(4)
manhole steps	7-05.3(1)F
metal poles & pedestals, under base plate	8-32.3(1)B
mix designs	9-04.3(2)
parking meter post	8-21.3(2)B
pipe connection, catch basin and inlet	7-05.3(2)B, 9-12.4(3)
pipe connection, existing manhole	7-05.3(1)S, 9-12.4(3)
pipe connection, flow control structure	7-16.3(2), 9-12.4(3)
pipe connection, precast manhole	7-05.3(1)N, 9-12.4(3)
signals & lighting poles & pedestals	9-33.1(7)
surface preparation and application	6-02.3(3)D
sewer and drainage structures	9-12.4(3)
Grout, other than non-shrink cement applications	
anchor bolts and bridge bearings	6-02.3(20)
anchor bolts, placing	6-02.3(18), 6-03.3(35)
anchor, bridge approach slab	5-05.3(19)
anchoring rebar and rod in concrete holes	6-02.3(30)
beam guardrail anchors	9-16.3(5)
cast-in-place prestressed concrete tendons	6-02.3(26)G
concrete pavement spall repair	5-05.3(22)
curb dowel, epoxy grout	8-04.2, 8-04.3(5)A
expansion joint, concrete structure	6-02.3(13)A
guy-wire anchor, wire fence	8-12.3(3)B
jet-set for direct burial parking meter posts	9-28.2(2)
patching concrete after concrete removal	6-02.3(34)A1
post, chain link fence	8-12.3(2)A
post, wire fence and gates	8-12.3(3)A
prestressed concrete girder, placing before erection	6-02.3(25)O
repair of spalled and delaminated concrete	6-02.3(32)
steel bearing plate, placing under	6-03.3(36)
wire mesh slope protection	9-16.4(6)
Grubbing	2-01.3(2)
Guarantees	1-05.10
Guaranty, bid	1-02.7
Guaranty, bid (defined term)	1-01.3
Guaranty, bid, return of	1-03.6
Guardrail	
construction	8-11
non-weathering steel	9-16.3
weathering steel	9-16.8
Guide Posts, flexible	9-17

H

Hammer, pile driving	6-05.3(1), 6-05.3(9)
Hand holes in structural steel	6-03.3(19)
Handholds	
in precast concrete cones	7-05.3(1)6
steps, ladders and	7-05.3(1)Q, 9-12.2
Handholes	
electrical	8-33.3(4), 9-34.6
in pedestal	9-33.6
in pole, aluminum	9-33.3
in pole, steel	9-33.2(5)
Hankinson formula, reference for bolted timber connections	6-02.3(17)J
Haul	2-04
Headwalls	7-03.3(5)
Health and safety	
electrical	1-05.2(2)
hazardous waste sites – see Section 1-07.30 of the project manual	
in general	1-07
Helmet, pile driving	6-05.3(1)
High strength bolts	
holes in steel for	6-03.3(22)
material specifications	9-06.5(3)
Holes	
drilling in concrete	6-02.3(30)
drilling in steel eyebars for pins	6-03.3(20)
drilling in steel for high strength bolts	6-03.3(27)
drilling in steel pins and rollers	6-03.3(24)
epoxy bonding rebar & rod in concrete	6-02.3(31)

2003 City of Seattle Standard Specifications for Road, Bridge, and Municipal Construction

high strength bolts in structural steel	6-03.3(27)
pins and rollers, structural steel	6-03.3(24)
punched, reamed, sub-punched	6-03.3(27)
timber structures, bolts, dowels, rods, lag screws	6-04.3(5)
weep, for concrete slab riprap	8-15.3(5)
weep, drainage of substructure	6-02.3(22)
Holiday (defined term)	1-01.3
Holiday detection	
multi-layered polyethylene coating for water main	9-30.1(6)B
thermoplastic coating for water main	9-30.1(6)C5
Hydrant wall	7-14.3(9)
Hydrants	7-14, 9-30.5
Hydroseeding	8-01.3(4) and (5)
Hydrostatic test for sanitary force main	7-17.3(4)F

I

Illuminated sign, overhead interior	8-31.3(6)
Illumination - see "Lighting / illumination"	
Incompetent workmen	1-05.13
Increased or decreased quantities	1-04.6
Indemnification - see "Insurance"	
Inlets	
adjustment to finished grade	7-20.3(2)
cast metal	9-12.8(3)
connections	7-08.3(5)
construction requirement	7-05.3(2)
drop inlet and grate inlet	9-12.13
Inspection	
final, of work	1-05.11
work and materials, of	1-05.6
Inspector - see "Assistant"	
Insurance	1-07.18
workers benefits	1-07.18(8)
indemnification	1-07.18(7)
Intent of contract	1-04.1
Interconnect cable	8-31.3(8), 9-32.9
Interior illuminated sign, overhead	8-31.3(6)
Interlocking concrete pavers	8-14.3(10), 9-14.9Irrigation system 8-03, 9-15
Items of work and units of measurement	1-01.2(2)

J

Jet-set cement for direct burial parking meter post	9-28.2(2)
Job shack - see "Field office"	
Joints, concrete structure	
compression seals, and expansion joints	6-02.3(13)
construction	6-02.3(12)
Joints, irrigation system, pipe	8-03.3(5)
Joints, pavement, sidewalk, driveway, and related	
curb and gutter, concrete	8-04.3 (1) F
curb, extruded	8-06.3(5)
driveway, concrete	8-19.3(3)
pavement, asphalt	5-04.3(11)
pavement, concrete	5-05.3(8)
sidewalk, concrete	8-14.3(6)
Joints, sewer and drainage	
connections, at catch basin, inlet, manhole	7-08.3(3)
culvert pipe, concrete	7-02.3(1)B
drain pipe	7-01.3(2)
materials, various type pipe applications	9-05
miscellaneous pipe connections	7-08.3(3)
sewer and drainage, gasketed	7-17.3(2)E-F
sewer and drainage, hand mortared & on curves	7-17.3(2)B2
side sewer	7-18.3(3)D
structure, manhole	7-05.3(1)K
Joints, watermain	
bond cable	9-30.10
ductile iron	7-11.3(6)
electrolysis, joint bonding	7-11.3(15)
restrained	9-30.2(6)
Joint and crack sealing materials	9-04
Joint venture, business (defined term)	1-01.3
Junction box, drainage	7-02.3(2), 9-12.9
Junction and terminal boxes, electrical	9-32.11(5)

2003 City of Seattle Standard Specifications for Road, Bridge, and Municipal Construction

K (none)

L

Labor and Industries, State Department of	
flagging	1-10.1(3)A
safety rules and standards	1-07.1(2)
subcontracting	1-08.1(3)
wages	1-07.9
workers benefits	1-07.18(8)
Labor prevailing wage rates	1-07.9(1)
Laboratory (defined term)	1-01.3
Ladders, steps, and handholds for manholes	7-05.3(1)Q, 9-12.2
Laminated concrete repair	6-02.3(32)
Laminated floor, timber structures	6-04.3(15)
Landscaping - see "Roadside planting"	
Landslide prone areas, flow control structures	7-16.2
Lane markers and traffic buttons	8-08, 9-21
Laws, to be observed	1-07.1
Legal relations and responsibilities to the public	1-07
Licenses, permits and	1-07.6
Lighting / illumination	8-30, 9-31
Lime, agricultural	9-14.3(2)
Liquidated damages	
amount of – see agreement form in the project manual	
contract time overrun	1-08.9
defined term	1-01.3
Load limits	1-07.7
Locator, underground facility / construction notification requirement	1-07.17(1), 1-07.28
Log of test borings, subsurface information	1-02.4(2)
Logs of soil borings – see appendix of the project manual	
Loose riprap	8-15.3(2), 9-13.2
Lumber	
formwork and falsework for concrete structures	6-02.3(17)
material requirements	9-09
timber structures, construction requirements	6-04
Luminaire	8-30.3(2), 9-31.1
Luminaire arm - see "Bracket arm"	

M

Machinery, contractor's equipment and	1-05.9
Maintenance, during suspension of work	1-08.7
Maintenance rock	9-03.9(4)
Manholes	
adjusting to finished grade	7-20
construction requirements	7-05.3(1)
material specifications	9-12
Manufacturers certificate of compliance	1-06.3
Marking on pavement	
asphalt pavement construction	5-04.3(17)
concrete pavement construction	5-05.3(17)
construction under traffic	1-07.23(1)
designations and construction requirements	8-22
removal	2-02.3(3)J
temporary traffic control	1-10.3(4)C
Materialman (defined term)	1-01.3
Materialmen, prompt payment to	1-09.14
Materials	
acceptance	1-06.2
American-made requirements - see Section 1-06.5 in the Project Manual	
found on project site, use of	1-04.10
inspection of work and	1-05.6
on hand, payment for	1-09.8
Matting	
material specifications	9-14.5
placing for erosion control	8-01.3(8)
Measurement and payment	1-09
Measurement of quantities	1-09.1
Mechanical splices, rebar	6-02.3(24)G
Mediation	1-04.5(4)
Mesh	
for wire fence	9-16.2(7)
wire, for concrete reinforcement	9-07.7
Mineral aggregates	9-03
Mobilization, payment for	1-09.7
Mobilization, payment for force account	1-09.6(6)

2003 City of Seattle Standard Specifications for Road, Bridge, and Municipal Construction

Moisture cured urethane paint	6-07.3(7), 9-08.2 item 18.
Monorail, Seattle, notification when construction near	1-07.28
Monument cases (frame and cover)	8-13, 9-22
Mortar for	
edge support wall	9-04.3(1)
hand mortared concrete culvert pipe joint	9-04.3(1)
sewer and drainage structures	9-12.4
water valve chamber brick and block	9-30.3(12)E
water valve chamber plaster-coating	9-30.3(12)I
waterproofing cement concrete surfaces	6-08, 9-11.3
Mulches and mulch amendments	9-14.4

N

Navigable streams affected by structures	6-01.7
Noise pollution	1-07.5(4)
Non-discrimination requirements, equal employment opportunity and	1-07.11
Noncollusion, bidder requirement	1-02.8
Normal temperature, bridge drawings dimensions	6-01.15
Notice – see "Written notice"	
Notice of award (defined term)	1-01.3
Notice to proceed (defined term)	1-01.3
Notice to proceed (NTP) and prosecution of the work	1-08.4
Notifications required by contractor's - construction / excavation / inspection	
backflow prevention device inspection	1-07.28, item 5
blocking arterial, street, sidewalk, alley	1-07.28, item 1
chemical, oil, or contaminant spill	1-07.28, item 8
construction near Seattle Monorail facilities	1-07.28, item 9
electrical safety observer	1-07.28, item 6
entry onto private property	1-07.28, item 13
loop detection systems near signalized intersections	1-07.28, item 15
METRO and waterfront trolley overhead wires, construction near	1-07.28, item 11
METRO transit service disruption	1-07.28, item 2
monorail, construction near	1-07.28, item 9
overhead utility lines and trees	1-07.28, item 10
overhead METRO and Waterfront street car wires	1-07.28, item 11
parking meters, covering	1-07.28, item 1
parking restrictions	1-07.28, item 1
pavement problems, emergency	1-07.28, item 4
property access restrictions	1-07.28, item 3
sanitary sewer spill	1-07.28, item 7
sidewalk problems, emergency	1-07.28, item 4
tree trimming or felling near overhead power lines	1-07.28, item 10
underground facility locate (one call)	1-07.28, item 12
underground electrical transmission system	1-07.28, item 6
U.S. Postal Service collection boxes and mail receptacles	1-07.28, item 14
water main, hydrant, water service shutdown and obstruction	1-07.28, item 5
water main clearances with other facilities	1-07.28, item 5
water service transfer	1-07.28, item 5

O

Odor and taste testing for water mains	7-11.2(2) and (3)
"One call" underground facility locate service	1-07.17(1)
On-site lead, electrical	
defined term	1-01.3
responsibilities	1-05.2(2)
Opening	
bids, public contracts	1-02.12
bridge roadway slabs	6-02.3(23)
concrete pavement to traffic	5-05.3(17)
of sections to traffic	1-07.25
Operational testing, final inspection	1-05.11(3)
"Or equal"	1-06.1
Oral agreements	1-05.17
Ordering water service transfers	1-07.28, 7-15
Outlet traps	9-12.12
Overbreak	2-03.3(12)
Overhead interior illuminated sign	8-31.3(6), 9-32.7
Overhead METRO trolley lines, construction near, notification requirement	1-07.28
Overhead power lines & tree trimming - construction notification requirement	1-07.28
Overtime	
contractor employees	1-07.9(1)B
force account, labor	1-09.6(2)
owner employees, reimbursement for	1-08.1(5)
owner's right to withhold and disburse certain amounts	1-09.9(3)
Overweighing / underweighing and pay adjustment	1-09.2(5)

2003 City of Seattle Standard Specifications for Road, Bridge, and Municipal Construction

Overweight loads, over bridges and culverts	1-07.7
Owner (defined term)	1-01.3
Owner, rights of the	1-03.1(5)
Owner's right to correct defective or unauthorized work	1-05.8

P

Paint	
film thickness	6-07.3(5)
formulas	9-08.2
materials	9-08.1
moisture cured urethane paint (formula no. 18)	9-08.2
Painting	6-07
painting hydrants	7-14.3(11), 9-30.5(7)
shop painting steel members	6-03.3(30)
Parking meter post installation	8-21.3(2)B
Parking meter post, material specifications	9-28.2(2)
Parking restriction - construction notification requirement	1-07.28
Patented devices, materials and processes	1-07.20
Pavement, asphalt concrete	5-04
Pavement, cement concrete	5-05
Pavement removal	2-02.3(3)
Pavement marking	8-22, 9-29
Pavement marking removal	2-02.3(3)J
Pavement marking, temporary, new asphalt pavement	5-04.3(17)
Pavement marking, temporary, new concrete pavement	5-05.3(17)
Pavers, interlocking concrete	8-14.3(10), 9-14.9
Pay - see "Wages"	
Payment, measurement and	1-09
Payroll reports	1-07.9(1)D
Pedestal, signal	9-33.6
Pedestrian control and protection	1-07.23(2)
Pedestrian signal heads	8-31.3(3)C, 9-32.4
Perforated drain pipe	7-01, 9-05.2
Performance evaluation program, contractor	1-05.13(2)
Permeability test, concrete pipe	9-05.7(1)A
Permits and licenses	1-07.6
Personal liability of officers and employees of owner	1-07.26
Piles and piling	6-05, 9-10
Pins and rollers, structural steel	6-03.3(24)
Pin nuts, adjusting	6-03.3(34)
Pipe	
material - irrigation	9-15
material - sewer and drainage	9-05
material - structural plate, arch, and underpass	7-03
material - water main	9-30
pipe installation - miscellaneous pipe connections	7-08
pipe installation - culverts	7-02
pipe installation - drains	7-01
pipe installation - plate, arch, and underpass	7-03
pipe installation - sanitary sewer and storm drain	7-17
pipe installation - sewer cleanout	7-19
pipe installation - side sewer	7-18
pipe installation - water main	7-11
Pipe anchors	7-06
Pipe and fittings for water mains	7-09
Pipe bedding, controlled density fill (CDF) – see Controlled Density Fill	
Plan, contractor required submittal – also see "Shop drawings"	
falsework & formwork – temporary footing & mudsill bearing test	6-02.3(17)E
falsework & formwork support system – pile bearing test	6-02.3(17)E
interconnect cable, old to new	8-31.3(8)A
jacking irrigation piping	8-03.3(4)
prestress concrete girder erection	6-02.3(25)O
reclamation	3-03.3
reclamation, borrow and waste sites	2-01.2
removal of falsework and formwork	6-02.3(17)O
removal of structural concrete	6-02.3(34)A
repair, rejected pole	8-32.3(1)A
structural steel erection	6-03.3(7)B
structural steel marking	6-03.2
temporary traffic control	1-10.2(5)
temporary water pollution/erosion control	1-07.15
traffic signal controller modification	8-31.3(2)A
weed control, landscape establishment	8-02.3(12), item 8
Plans – see "Drawings"	
Plant materials	9-14.6
Planting, landscape – see "Roadside planting"	

2003 City of Seattle Standard Specifications for Road, Bridge, and Municipal Construction

Plastic covering, clear	
construction requirement	8-01.3(8)
material specification	9-14.5(3)
Plastic foam (ethafoam)	9-05.14
Plastic lane markers and traffic buttons	8-08, 9-21
Plastic waterstop	9-24
Plate girders, steel	6-03.3(21)
Platform scales	1-09.2(3)
Playfield soil	8-01.3(2)D, 9-14.1(4)B
Plugging existing culvert	7-02.3(5)
Plugging existing pipe	2-02.3(5)B
Poles, signal and electric	
aluminum	9-33.3
and traffic signal system	8-31
back guy assemblies	9-33.8
construction requirements	8-32.3
foundations	8-32.3(2)
general pole requirements	9-33.1
pedestals, steel and aluminum	9-33.6
shop drawing submittal requirement	8-32.1(3)
steel	9-33.2
traffic sign installation on	8-21.3(1)
wood	9-33.4
Pollution, prevention of environmental & preservation of public natural resources	1-07.5
Polyethylene encasement (film wrap) for water main	7-11.3(6)B, 9-30.1(6)B
Polyethylene multi-layer coating for water main	7-11.3(6)C, 9-30.1(6)D
Portland cement	9-01
Posts	
beam guardrail, weathering and non-weathering	8-11.3(1), 9-16.3(2)
blockout in new concrete sidewalk for	8-14.3(3)
chain link fence and gate	8-12.3(2), 9-16.1(2)
flexible delineator	8-10
flexible guide	9-17
glare screen	8-25.3(3), 9-16.6(3)
handrail in concrete stairway	8-18.3(4)
metal bridge railing	9-06.18
parking meter	8-31.3(2), 9-28.2(2)
pedestrian pushbutton	9-33.7
project identification sign	8-27.2(5)
roadside sign structure	9-06.16
sign, wood	8-21.3(2), 9-28.2
silt fence	2-12.3(6)B
street name sign	9-28.2(4)
wire fence and gate	8-12.3(3), 9-16.2(2)-(3)
wood post lumber specifications	9-09
Pre-award information	1-03.1(4)
Precast concrete piles	6-05.3(3) and (7)B
Precast traffic curb and block traffic curb	8-07, 9-18
Precedence, order of contract components	1-04.2
Preconstruction conference	1-08.1(2)
Preliminary critical path schedule	1-08.3(1)
Premolded joint filler	
for concrete pavement joints	5-05.3(8), 9-04.1
for concrete structure joints	6-01.14
Preservation of public natural resources	1-07.5
Preservative treatments for timber	9-09.3
Prestressed concrete girders	6-02.3(25), 9-19
Prestressing reinforcement	9-07.10
Prevailing wage rates	1-07.9(1)
Prevention of environmental pollution	1-07.5
Private property	
notification requirement, construction access limitations and entry onto	1-07.28
real property rights	1-07.24
Production from quarry and pit sites	3-01
Professional engineer, submittal prepared by	1-05.3(2)F
Progress estimates and payment	1-04.8, 1-09.9
Progress schedule to be furnished by contractor - see "Critical path schedule"	
Project manual (defined term)	1-01.3
Project site (defined term)	1-01.3
Prompt payment to subcontractors and materialmen	1-09.14
Property, protection and restoration of	1-07.16
Proposal – see "Bid"	
Prosecution and progress	1-08
Process, dispute resolution	1-04.5
Protection and restoration of property	1-07.16
Protection of utilities – see "Utilities and similar facilities"	
Pruning and staking of plant material	8-02.3(7)

2003 City of Seattle Standard Specifications for Road, Bridge, and Municipal Construction

Public convenience and safety	1-07.23
Public officers and employees of owner, no personal liability of	1-07.26
Public opening of bids	1-02.12

Q

Qualifications of bidders	1-02.1
Quarry and pit sites	3-01
Quantities	
increased or decreased	1-04.6
measurement of	1-09.1
Quick coupling valves, irrigation	9-15.7(3)

R

Railings, bridge and pedestrian	6-06
Railings for concrete stairways and landings – also see "Handrails"	8-18.2, 8-18.3(4)
Railroads, relations with the – see section 1-07.31 of the project manual	
Real property	1-07.24
Rebuild existing catch basin	7-05.3(2)F
Rebuild existing manhole	7-05.3(1)U
Reinforcing steel (also called "rebar")	9-07
Rejection of bids	1-02.13, 1-02.14
Rejuvenating (recycling) agents, asphalt	9-02.1(5)
Relief of responsibility for completed work	1-07.13(2)
Relief of responsibility for damage by public traffic	1-07.13(3)
Removal of	
defective and unauthorized work	1-05.7
falsework and forms, structural concrete	6-02.3(17)O
structural concrete, bonding new concrete to existing concrete	6-02.3(34)
unacceptable paint	6-07.3(1)E
Remove, abandon, or relocate structures and obstructions	2-02
Rented equipment, payment for force account work	1-09.6
Repainting existing steel structure	6-07.3(2)
Responsibility for work and damage, contractor's	1-07.13
Retainage	1-09.9(2)
Retaining walls – also see "Rock facing"	
Retaining walls for hydrants	7-14.3(9)
Right-of-way (defined term)	1-01.3
Rights of the owner	1-03.1(5)
Riprap	8-15
Roadbed (defined term)	1-01.3
Roadside cleanup	2-01, 1-04.11
Roadside planting	8-02, 9-14
amendments, mulches and	8-02.3(9), 9-14.4
benches	8-02.3(20), 9-14.13
bollards	8-02.3(19), 9-14.12
cedar edging	9-14.11
chemical pesticides	8-02.3(3)
cultivation and cleanup	8-02.3(11)
edging	8-02.3(18)
fertilizer	8-02.3(8), 9-14.3(1)
grid blocks	8-02.3(17)
landscape establishment	8-02.3(12)
lawn establishment	8-02.3(15)
lawn installation	8-02.3(14)
layout of planting	8-02.3(5)
matting	9-14.5
mulch amendment	8-02.3(9), 9-14.4
paver blocks and interlocking pavers	8-02.3(16), 9-14.9
plant materials	9-14.6
planting	8-02.3(6)
planting area preparation	8-01.3(4)
planting soil and playfield soil	9-14.1(4)
pruning and staking	8-02.3(7)
relocate tree	8-02.3(22)
removing / trimming trees near overhead wires	1-07.16(2)
removing / trimming trees near overhead wires – notification requirement	1-07.28
seed mixes	9-14.2
shear boards	9-14.8
sod	9-14.6(8)
soil amendments	8-02.3(10)
stakes, guys, wrapping	9-14.7
substitution of plants	9-14.6(6)
temporary storage of plant materials	9-14.6(7)
topsoil, types A and B	9-14.1(1) and (2)
tree grates	8-02.3(21), 9-14.14

2003 City of Seattle Standard Specifications for Road, Bridge, and Municipal Construction

tree root pruning.....	8-02.3(23)
tunneling or trenching, and tree roots	1-07.16(2)
turf reinforcement.....	9-14.10
Roadway	
classification of excavation	2-03.1(2)
cut slope treatment	2-03.3(5)
ditches.....	2-03.3(9)
embankment construction.....	2-03.3(14)
excavation and embankment	2-03
rock cuts.....	2-03.3(2)
Rock drilling safety requirements	1-07.21
Rock facing	2-08, 9-03.17
Rollers	
asphalt concrete pavement construction	5-04.3(4)B
bituminous surface treatment.....	5-02.3(1)
Rubber gasketed joint applications	
ABS composite pipe	9-05.15
concrete pipe	9-05.7(3)
culvert, concrete.....	7-02.3(1)B2
ductile iron sewer and storm drain	9-05.13
manhole, precast	7-05.3(1)K, 9-12.4(1)
material specifications	9-04.4
pedestrian push button assembly	9-32.5
water main, insulating couplings	9-30.2(7)A
water main, non-restrained ductile iron pipe	9-30.1(1)
Rubberized asphalt for crack sealing	5-04.3(5)D, 9-04.10

S

Sack riprap	8-15.3(4), 9-13.4
Safety observer, electrical – see "Electrical safety observer"	
Safety Rules and Standards	1-07.1(2)
Safety systems for trench excavation	7-17.3(1)A7a
Safety watch, construction in electrical vault – see "Electrical safety observer"	
Sales tax, state	1-07.2
Salvage of usable materials	2-02.3(7)
Samples and sampling of materials	
acceptance	1-06.2
inspection of work and material	1-05.6
Sand drainage blanket	2-03.3(14)I, 9-03.13(2)
Sand/silt ratio	9-00.6
Sanitation, contractor requirements	1-07.4
Sanitary sewer spill, notification requirement	1-07.28
Sanitary sewers - see "Storm drain and sanitary sewer"	
Sawcutting, planing, and grinding byproducts, pollution control	1-07.5(2)
Sawing and line drilling	2-02.3(6)
Scales, weighing equipment	1-09.2
Schedule, critical path	1-08.3(1)
Scope of payment	1-09.3
Scope of work	1-04
Screw threads, standard	6-03.3(26)
Seal, foundation, placing concrete in	6-02.3(6)C
Seals, copper	9-06.13
Seattle Monorail, construction near – notification requirement	1-07.28
Seeding	
erosion control	8-01.3(4)
lawn installation	8-02.3(14)
Selected material	2-03.3(10)
Service connection transfers, water	7-15
Sewer (defined term)	1-01.3
Sewer cleanouts	7-19
Sewer, sanitary spill - notification requirement	1-07.28
Sewers, sanitary and combined - see "Storm drain and sanitary sewer"	
Shear	
allowable stresses in formwork and falsework	6-02.3(17)C
boards, erosion control	8-01.3(12), 9-14.8
connectors, welded	9-06.15
gate in flow control structure	9-05.19
hydrant shear block	9-14.3(1)
keys at concrete construction joints	6-02.3(12)
Shop drawings	
defined term	1-01.3
general submittal requirements	1-05.3(2)
Shoring and cofferdams, structure excavation	2-09.3(3)D
Shoulder, ballast	4-04.3(11), 9-03.9(2)
Shutdown of water main or service - construction notification requirement	1-07.28
Side sewers	7-18

2003 City of Seattle Standard Specifications for Road, Bridge, and Municipal Construction

Sidewalk, close or restrict access during construction – notification requirement	1-07.28
Sidewalks, cement concrete	8-14
Sieve analysis for aggregate, methods	9-03.15
Sign, overhead interior illuminated	8-31.3(6), 9-32.7
Sign posts, timber	9-28.2(1)
Signal controller - see "Traffic signal controller"	
Signal system, traffic – construction requirements	8-31
check-out procedure	8-31.3(15)
controller assembly	8-31.3(2)
detector loops	8-31.3(5)
field tests	8-31.1(5)D
final inspection and as-built drawing	8-31.3(17)
grounding and bonding	8-31.3(10)
interconnect cable	8-31.3(8)
intersection check-out & turn-on procedure	8-31.3(1)
pedestrian pushbutton assembly	8-31.3(4)
pole line hardware installation	8-31.3(11)
relocating equipment	8-31.3(12)
signal heads, vehicle and pedestrian	8-31.3(3)
signal wiring	8-31.3(9)
turn-on/cut-over procedure	8-31.3(16)
Signal system, traffic – material requirements	9-32
detector loops	9-32.6
interconnect cable	9-32.9
overhead interior illuminated sign	9-32.7
pedestrian heads	9-32.4
pedestrian push button assembly	9-32.5
signal wiring	9-32.11
span wire	9-32.12
vehicle heads	9-32.3
Signs and posts, street and traffic	8-21, 9-28
Site conditions, differing	1-04.7
Site, examination of bid documents and	1-02.4
Site reclamation – borrow, quarry, pit	3-03
Sleeve	
for irrigation pipe	9-15.3
for parking meter post	9-28.2(2)
for water main – ductile iron pipe fittings	9-30.2(1)
for water main – heat shrink joint	9-30.1(6)E
for water main – insulating flange kits	9-30.2(7)B
for water main – joint bond cable	9-30.10
for water main – thermite weld adapter	9-30.11(2)
Slope protection	
concrete	8-16
wire mesh	8-29
Slump test	
pavement concrete consistency	5-05.3(2)
structure concrete consistency	6-02.3(4)E
Smoothness	
asphalt concrete pavement surface	5-04.3(13)
concrete pavement surface	5-05.3(12)
Source of supply and quality of materials	1-06.1
Special provisions (defined term)	1-01.3
Specifications	
coordination with contract	1-04.2
defined term	1-01.3
Stairway, cement concrete	8-18
Stakes, construction	1-05.5
State sales tax	1-07.2
Steel structures	
construction requirements	6-03
materials	9-06
Steel reinforcing bar ("rebar")	9-07
Stepped slope construction	2-03.3(18)
Steps, cement concrete	8-18
Steps, handholds & ladders for sewer & drainage structures	7-05.3(1)Q, 9-12.2
Storm drain and sanitary sewer pipe construction requirements	7-17
backfilling trenches	7-17.3(3)
bedding	7-17.3(1)B
cleaning and testing	7-17.3(4)
pipe installation	7-17.3(2)
tee, cut-in	7-17.3(2)C3
television inspection	7-17.3(4)I
temporary sewer bypass	7-17.3(2)K
trench excavation	7-17.3(1)A
trench safety systems	7-17.3(1)A7a
trench support systems	7-17.3(1)A7b

2003 City of Seattle Standard Specifications for Road, Bridge, and Municipal Construction

underground construction	7-17.3(2)J
Storm drain and sanitary sewer – pipe materials	
pipe gaskets – flexible plastic	9-04.5
pipe gaskets - rubber	9-04.4
pipe materials	9-05
Straw mulch	9-14.4(1)
Strength requirements of	
pavement concrete	5-05.3(1)
structural concrete	6-02.3(2)A
Structural backfill, Controlled density fill (CDF) – see Controlled density fill	
Structural plate pipe, pipe arch, arch, and underpass	7-03
Structural steel and related materials	9-06
Structure excavation	2-09
Structures - general requirements	6-01
Subcontracting requirements	1-08.1(3)
Subcontractor / bidder list	1-02.9(3)
Subcontractor - defined term)	1-01.3
Subcontractors, prompt payment to materialmen and	1-09.14
Subgrade preparation	2-06
Submittal, bid	1-02.9
Submittal prepared by professional engineer	1-05.3(2)F
Submittals, contractor required	1-08.3
Subsealing	5-01
Substantial completion date	1-05.11(1)
Substantial completion (defined term)	1-01.3
Substitution	
"or equal"	1-06.1
shop drawings requirements	1-05.3(2)
structural steel sections	6-03.3(8)
Subsurface information	1-02.4(2)
Subsurface drain	7-01, 9-05.2
Superintendents, labor, and equipment, contractor	1-05.13
Superstructure (defined term)	1-01.3
Supplemental contract (defined term)	1-01.3
Support system, trench excavation	7-17.3(1)A7b
Support wall and edge wall	5-05.3(23)C
Surety (defined term)	1-01.3
Surfacing, ballasting and crushed	4-04
Surplus material, disposal	2-03.3(7)
Survey, construction stakes	1-05.5
Suspension of work	1-08.6

T

Tack coat, asphalt paving	5-04.3(5)B4
Taste and odor testing for water mains	7-11.2(2), 7-11.2(3)
Tax, state sales	1-07.2
Tee, cut-in on existing or new sewer/drainage pipe	7-17.3(2)C3
Temperature, normal for bridge drawing dimensions	6-01.15
Temporary concrete barrier	
construction requirement	6-10.3(5)
for traffic control	1-07.23(1)
Temporary traffic control	1-07.23, 1-10
Temporary water service connection	7-10.3(6)
Temporary water pollution/erosion control	1-07.15
Terminated or deleted work	1-09.5
Termination of contract	1-08.10
Test piles	6-05.3 (10)
Thermoplastic powder coating for water main	9-30.1(6)C
Three edge bearing test, concrete pipe	9-05.3(2)C
Tie bars, pavement	5-05.3(10), 9-07.6
Timber and lumber materials	9-09
Timber structures	6-04
Time, contract	
defined term	1-01.3
extensions and delays	1-08.8
for completion	1-08.5
Time to execute agreement form	1-03.3(2)
Topsoil and playfield soil	8-01.3(2), 9-14.1
Traffic buttons and lane markers	8-08, 9-21
Traffic control during construction	1-07.23, 1-10
Traffic control for traffic signal construction	8-31.3(1)A
Traffic curb, precast and block	8-07, 9-18
Traffic signal controller assembly	8-31.3(2)
Traffic signals - see "Signal system, traffic"	
Training and promotion	1-07.11(7)
Traps, outlet	9-12.12

2003 City of Seattle Standard Specifications for Road, Bridge, and Municipal Construction

Traveled way (defined term)	1-01.3
Treated timber, preservative treatment	9-09.3
Treatment, protective - aluminum pipe in contact with portland cement concrete	7-02.3(1)C3b
Tree, relocate	8-02.3(22)
Tree root pruning and excavation	8-02.3(23)
Tree trimming and overhead wires – notification requirement	1-07.28
Trench backfill, controlled density fill (CDF) – see Controlled density fill	
Trench excavation, sewer and storm drain	
pipe connections, catch basin & inlet	7-08.3(1)
detention pipe	7-16.3(1)
general	2-09.3(4)
protective system	7-17.3(1)A7
safety system	7-17.3(1)A7a
side sewer	7-18.3(2)
storm drain & sewer	7-17.3(1)
support system	7-17.3(1)A7b
Trench excavation, water main	6-10.3(5)
construction requirements	7-10.3(7)
protective system	7-10.3(7)G
safety system	7-10.3(7)G1
support system	7-10.3(7)G2
Trestle ends, embankment at bridge and	2-03.3(14)J
Trimming and Cleanup	2-11

U

Unauthorized work, removal of	1-05.6, 1-05.7
Unavoidable delay	1-08.6, 1-08.8
Uncovering work, payment for	1-05.6
Underground construction	7-17.3(2)J
Underground utility clearances - see "Clearances with utilities"	
Underground utilities locate (one call locate) – notification requirement	1-07.28
Underpass, drainage	7-03
Underweighing / overweighing & pay adjustment	1-09.2(5)
Unfinished cement concrete pavement	5-05.3(20)
Urethane paint, moisture-cured	6-07.3(7), 9-08.2 item 18.
Usable materials, salvage of	2-02.3(7)
Use of buildings or other structures	1-04.9
Use of explosives	1-07.22
Use of materials found on the project site	1-04.10
Utilities and similar facilities	1-07.17
Utilities notifications requirements for various types constructions	1-07.28

V

Valves for irrigation	9-15.7
Valves for water mains	7-12, 9-30.3
Vault, electrical & electrical safety observer, notification requirement	1-05.5(2), 1-07.28
Vertical drains, prefabricated	2-03.3(14)I
Vibratory rollers	2-03.3(14)B, 5-04.3(4)B
Vitrified clay pipe	9-05.8

W

Wage rates, prevailing	1-07.9(1)
Wages	1-07.9
Wall	
concrete slab wall	8-15.3(5)
curb wall, edge wall, and support wall	5-05.3(23)
head wall	7-03.3(5)
retaining wall for fire hydrants	7-14.3(9)
Warranty and guaranty	1-05.10
Waste sites, disposal of waste, debris, surplus material	2-01.2, 2-03.3(7)
Wasting excavated material	2-03.3(8)
Watch, electrical safety – see "Electrical safety observer"	
Water	
for irrigation	9-25.2
for pavement concrete	5-05.3(5), 9-25.1
for structural concrete	6-02.3(4), 9-25.1
Water main and related - construction requirements	
clearances with other utilities	1-07.17(2)A
excavation, bedding, backfill	7-10
hydrants	7-14
materials	9-30
pipe installation, pressure and taste testing, connections, electrolysis monitoring	7-11
salvage of removed water main and related materials	2-02.3(7)B
trench excavation, bedding, and backfill	7-10

2003 City of Seattle Standard Specifications for Road, Bridge, and Municipal Construction

valves	7-12
Water quality, environmental construction requirements	1-07.5(2)
Water pollution / erosion control, temporary construction controls	1-07.15
Watering as part of various constructions	2-07
Waterproofing	6-08, 9-11
Waterstop, plastic	9-24
Wave equation analysis, piling	6-05.3
Weather limitations	
asphalt pavement construction	5-04.3(16)
bituminous surface treatment	5-02.3(10)
concrete pavement construction	5-05.3(14)
placing structural concrete	6-02.3(6)B
suspension of work	1-08.6
Weep holes	
concrete slab riprap	8-15.3(5)
concrete structures	6-02.3(22)
Weighing equipment	1-09.2
Welds	
reinforcing steel	6-02.3(24)F
structural steel	6-03.3(25)
Wheelchair ramps (curb ramps)	8-14.3(7), 8-14.3(8)
Wheel guards and railings, timber	6-04.3(13), 6-06.3(1)
Wire, cold drawn for reinforcing	9-07.9
Wire fence	8-12, 9-16.2
Wire mesh slope protection	8-29
Wiring, fusing and splicing, electrical	8-30.3(5), 9-31.5-6
Withdrawal or modification of bid	1-02.10
Women and minority business enterprise requirements	1-07.12
Work	
changes	1-04.4
completion	1-05.12
contractor's responsibility for damage and	1-07.13
defective and unauthorized	1-05.7
defined term	1-01.3
delays, time extensions and- entitlement & compensation	1-08.8
differing site conditions	1-04.7
force account payment	1-09.6
increased or decreased quantities	1-04.6
inspection of	1-05.6
samples and sampling	1-06.2
suspension	1-08.6
time for completion	1-08.5
Workers benefits - see "Insurance"	
Working day, defined term	1-01.3
Working hours	1-08.1(4)
Written notice (defined term)	1-01.3
Written notice	
defined term	1-01.3
method of serving	1-05.15

X, Y, Z (none)

Can't find an item in the Standard Specifications Index? Found an error for an item listed in the Standard Specifications Index? Help us improve the Index by sending us your suggestion or comment by using the "comment" feature at <http://www.seattle.gov/util/engineering>.